TENDER NO: DLI/CON/696/478

TENDER DOCUMENT

FOR

TENDER FOR CONSTRUCTION OF 24 NOS. ASSISTANT PROFESSOR QUARTERS FOR PERMANENT CAMPUS OF CENTRAL UNIVERSITY OF JAMMU (CUJ) AT VILLAGE BAGLA, DISTT. SAMBA (J&K).

VOLUME – II

ADDITIONAL CONDITIONS OF CONTRACT, TECHNICAL SPECIFICATIONS AND DRAWINGS

EXECUTING AGENCY

ENGINEERING PROJECTS (INDIA) LIMITED
(A GOVT. OF INDIA ENTERPRISE)
Core-3, Scope Complex, 7, Lodhi Road, New Delhi-110003
TEL NO: 011-24361666, FAX NO. 011-24363426
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**ADDITIONAL CONDITIONS OF CONTRACT (ACC)**

1.0 The following Additional Conditions of Contract shall be read in conjunction with General Conditions of Contract. If there are any provisions in these Additional Conditions of Contract, which are at variance with the provisions of General Conditions of Contract, the provisions in these Additional Conditions of Contract shall take precedence.

2.0 **INTRODUCTION**

The Central University of Jammu (CUJ) has been established by an Act of Parliament in the year 2009. In order to create one of India's leading Universities, the CUJ has contemplated to develop the campus equipped with modern infrastructure with latest facilities in the emerging educational needs. The site allotted for the establishment of Central University of Jammu is semi-mountainous, undulating and is surrounded by dense bushes and forest cover. The proposed site measuring approx. 610 acres is located at village Bagla, Distt. Samba (J&K) at approx. 25 km from Jammu & around 8 km from Rayha Morh on Jammu – Pathankot Highway (NH1A). The permanent Campus of CUJ shall be developed in 3 phases each of 5 years. The first phase of the permanent campus will have Institutional, Residential Buildings and external development work, conforming to the norms of the green building technologies “Green Rating for Integrated Habitat Assessment” (GRIHA) 5 Star Rating.

The presently administrative office of Central University of Jammu is functioning from the hired accommodation at 8/8, Trikuta Nagar, Jammu.

**FEATURES / DETAILS OF CUJ CAMPUS**

i) One overhead electrical L.T. Line within the plot area.
ii) Trees within the land.
iii) National Highway (NH1A) popularly known as Jammu to Pathankot highway is at around 8 km (Raya Morh) from the plot boundary of university.
iv) Jammu – Pathankot railway track is at around 6 km from plot boundary.
v) Plot is presently surrounded by Village Bagla & Sujani and farms.
vi) 5 mtr. (Approx) wide approach road from National Highway (Raya Morh) to village Mandal through University site is existing.
vii) Electricity is available in the Proposed University Campus.

3.0 **APPROACHES TO WORKSITE**

The contractor shall make his own arrangement for approach to work site including borrow/ disposal area and for movement of men, materials, machineries, other equipment etc. required for carrying out the work under this contract.
The access roads/path to the work site may not be available at all places and at all times. The contractor shall plan his work as per the availability of access roads/path at site. All drainage of works area and all weather truckable haulage roads as required by the contractor shall be constructed and maintained during the construction period by the contractor at his own cost, including portions of the road already existing.

4.0 WATER AND ELECTRICITY

The contractor shall make his own arrangement for water and electrical power for construction and other purposes at his own cost. The contractor shall also make standby arrangements for water and electricity to ensure un-interrupted supply.

The contractor is advised to quote his rates for different works considering the above factors.

5.0 SCOPE OF WORK INCLUDED IN THE CONTRACT

The brief scope of work as mentioned below included in this tender shall include (but not limited to) Civil, Plumbing & Sanitary, Internal Electrical works for Construction of 24 nos. Asstt. Prof. qtrs. along with associated/allied services conforming to the norms of the green building technologies “Green Rating for Integrated Habitat Assessment” (GRIHA) 5 Star Rating for permanent campus of the Central University of Jammu at village Bagla, Distt. Samba (J&K).

a) Construction of Assistant Professors Quarters (24 residential units) consisting of 3 twins with 2 blocks per twin, each block having 4 residential units (3 twins x 2 blocks per twin x 4 units per block=24 residential units). Each unit is having 2 bedrooms, 1 living room, 1 dining room, 1 study, 1 kitchen and 2 toilets etc.

The scope of work covers the entire construction work comprising of civil construction of the buildings, area development, complete plumbing & sanitary fittings, internal electrical work including fitting & fixtures, lighting, power supply etc. and handling over the project to EPIL / CUJ. Apart from the above, any other services not covered above but required as per direction of EPI / CUJ are deemed to be included in the scope of work.

The scope of work included in this tender shall include (but not be limited to) Construction of Assistant Professor Quarter for permanent campus of central university of Jammu. The detailed scope of work shall include civil work including finishing, plumbing & internal electrical works. The work also includes Site Leveling/Grading & jungle clearance, any other services not covered above but required in totality for overall completion of work as per the direction of PMC/ CUJ for Central University of Jammu as per the scope of work, technical Specifications & other conditions specified in technical Specification (Vol-IIB), BOQ and elsewhere.

The CUJ intends to develop green complex & obtain “GOLD” rating of “GRIHA” for the proposed facilities included in the project. Bidder to familiarize the requirements and note that all requirements of “GRIHA - 5 Star” pertaining to construction for achieving the above targeted rating. No extra payment shall be made on this account.
6.0 QUALIFICATION OF TENDERERS

To be eligible for this tender the bidders should fulfill the requirements for eligibility as mentioned in the Notice Inviting Tender (NIT) and should submit detailed data and credentials set out in Clause No. 19.0 of ITT, NIT (Vol-I) of the tender. The bidders are required to fulfill all the eligibility criteria as stipulated in NIT documents and elsewhere in the Tender documents. The price bid of only those bidders who fulfill the eligibility criteria as per evaluation of EPI shall be opened. The decision of EPI/CUJ in this regard shall be final & binding on the bidders.

7.0 DISQUALIFICATION

The bidders may note that they are liable to be disqualified and not considered for the opening of Price Bid if;

a) Representation in the forms, statements and attachments submitted in the pre-qualification document are proved to be incorrect, false and misleading.

b) They have record of poor performance during the past 10 years such as abandoning the work, rescinding of contract for which the reasons are attributable to the non-performance of the contractor, inordinate delay in completion, consistent history of litigation / arbitration awarded against the contractor or any of its constituents or financial failures due to bankruptcy etc. in their ongoing / past projects.

c) They have submitted incompletely filled in formats without attaching certified supporting documents and credentials to establish their eligibility to participate in the tender.

d) If the bidders attempt to influence any member of the selection committee.

EPI reserves its right to take appropriate action including disqualification of bidder (s) as may be deemed fit and proper by EPI at any time without giving any notice to the contractor in this regard. The decision of EPI in the matter of disqualification shall be final and binding on the bidders.

8.0 EPI reserves the right to independently verify the performance of the bidder from the existing owners / users / owners’ Consultants. In case any execution of work/ Project is found to be performing unsatisfactorily, EPI reserves the right to reject the tender and price bid of such bidder shall not be opened, even if the bidder is meeting the technical and other qualifying requirements.

In such circumstances the bidder shall have no claim on EPI of whatsoever nature.

➢ Bidder’s specific attention is drawn to above clauses.

9.0 Clause no 1.0 of Instructions to Tenders i.e Mode of submission shall also include the following paras:

(a) The Envelope-1 shall also contain the documents meeting the eligibility criteria mentioned in “Notice Inviting Tender” Clause No. 1.0 (a) to (j), in addition to the documents mentioned in Clause No.1.0 (i) to (vi) given in Page No. (1) of “INSTRUCTIONS TO TENDERERS”.

Signature of Contractor 3 EPI
(b) The tenderer who download the tender documents directly from EPI’s website shall have to submit tender fees of Rs. 10,000/- (Rupees Ten Thousand only) (Non-Refundable) by Crossed Demand Draft favouring “Engineering Projects (India) Ltd.”, payable at Delhi along with their bid in Envelope-1.

10.0 CLAUSE NO.1.1 OF INSTRUCTIONS TO TENDERERS as given in Page (2) of INSTRUCTIONS TO TENDERERS stands amended as below:

First the Envelope-1 of the tenderer shall be opened. Tenderers who unconditionally accept the tender conditions, deposit the required Earnest Money, meet the eligibility criteria mentioned in clause no. 1.0 (a) to (j) of NIT, deposit the tender fees as defined above in Clause 9.0(b) of ACC and whose Techno-Commercial Bid is found suitable, shall be considered for the opening of their Price Bid and Envelope-2 of such tenderers shall be opened. The Tenders not accompanied by requisite Earnest Money and/or not accompanied by the requisite tender fees and / or not conveying un-conditional acceptance of tender conditions and / or not meeting the eligibility criteria or whose Techno-Commercial Bid are not found acceptable, shall be rejected and such tenderer shall not be allowed to attend Price Bid opening i.e. opening of Envelope-2.

11.0 Bidders must submit the unpriced copy of the price bid duly stamped & signed along with other documents in the techno-commercial bid as a confirmation of having quoted for all items of the price bid.

12.0 DRAWINGS

a) Before filling in the tender, the tenderer will have to check up all drawings and schedule of quantities and will have to get the immediate clarification from EPI on any point that he feels is vague or uncertain. No claim for damages or compensation will be entertained on this account, in future.

Figured dimensions are in all cases to be followed and in no case should they be scaled. Large scale details take precedence over small scale drawing, in case of the discrepancy; the contractor is to ask for clarification before proceeding with the work.

b) The drawings attached to the tender documents provide a general idea about the work to be performed under the scope of this contract. These are preliminary drawings for tender purpose only and are by no means the final/ GFC drawings and may not be showing the full range of the work under the scope. The details given in the tender drawings are tentative and likely to be changed / modified during the detailed engineering.

c) The work has to be executed according to “Good for Construction” drawings issued by Engineer-in-charge with addition and modifications made from time to time as and when required and approved by Engineer-in-charge. The drawing shall be progressively released to site before the start of the corresponding work.
Before the commencement of any item of work, the contractor shall correlate all the relevant architectural and structural drawings issued for the work and satisfy himself that the information available there from is complete and unambiguous. The discrepancy, if any, shall be brought to the notice of Engineer-In-Charge before the execution of work. The contractor alone shall be responsible for any loss or damage occurring by the commencement of work on the basis of any erroneous and/or incomplete information. Nothing extra shall be paid on this account.

d) The successful tenderer on receiving the letter of intent shall furnish the design & detailed/shop drawing for specialized work within the time schedule mentioned elsewhere.

All the drawings/documents shall be submitted in six sets (hard copies) and two sets soft copies for approval/reference/record of EPI/CUJ.

13.0 SPECIFICATIONS

a) The work under the contract shall be carried out in accordance with the schedule of items of work, the particular specifications drawings forming part of this tender document, and the general conditions and other provisions of the tender.

b) The work in general shall be carried out as per latest CPWD specifications New Delhi for Civil Works (updated with correction slips issued upto last date of submission of tender) and latest CPWD specification New Delhi for electrical works (updated with correction slips issued up to last date of submission of tender) unless otherwise specified in the nomenclature of the individual item or in the particular specifications of concerned items of works.

c) For items not covered under latest CPWD specification, for (Civil Works)/latest CPWD specification for Electrical Works and in particular specification or nomenclature of the individual item as above, the work shall be done as per latest relevant BIS codes of practice.

d) In case, specifications are not covered under para 13.0 (b) & 13.0 (c) above the work shall be carried out as per the provisions of technical specifications given in Vol. II.

e) In case of non availability of any specification in the above paras or any overlapping provisions, non-clarity on any issue, applicability of particular provision out of above, shall be decided by Engineer-in-Charge whose decision shall be final & binding on the contractor.

f) The contractor is responsible for executing and completing the work in accordance with the specified standards and specification and as per requirements of GRIHA-5 ratings. Construction quality control is intended to provide a comprehensive common and consistent framework of quality control which is comprised of two main elements.

- Testing
- Inspection
g) The contractor shall be responsible for the types of test to be carried out, frequency of testing and stage of testing as directed by Engineer-in-charge or as stipulated in Indian Standards / CPWD Specifications for relevant works. The cost of all these tests shall deemed to be included in the item rates quoted by the contractor.

14.0 The reinforcement steel used on the works shall be TMT bars by prime manufacturers i.e. SAIL, TISCO, RINL. The other provision of clause 45.2 of GCC remains unchanged.

The structured steel used on the works shall also be by prime manufacturers i.e. SAIL, TISCO, RINL.

15.0 SITE LABORATORY

As part of the contract the contractor shall provide and maintain a site laboratory for the routine testing of construction material under the direction and general supervision of Engineer-in-charge. The laboratory room shall be constructed and installed with the appropriate facilities. Temperature and humidity controls shall be made available wherever necessary during the testing of samples.

All equipments shall be provided by the contractor so as to be compatible with the specified testing requirements. The contractor shall maintain the equipment in good working conditions for the duration of the contract.

The Contractor shall provide approved qualified personnel to run the laboratory for the duration of the contract. The number of staff and equipment available must at all times be sufficient to keep pace with the sampling and testing programme as required by Engineer-in-charge. The laboratory Incharge of the contractor shall report to Engineer-in-charge.

The Contractor shall fully service the site laboratory and shall supply everything necessary for its proper functioning, including all transport needed to move equipment and samples to and from sampling points on the site etc.

The Contractor shall re-calibrate all measuring devices whenever so required by the Engineer-in-charge and shall submit the results of such measurements without delay.

For all other tests as required by Engineer-in-charge, the Contractor shall get the same carried out / conducted by approved testing Laboratory. In addition if, PMC /CUJ feels, may direct the Contractor to conduct the tests in the presence of PMC/CUJ representative at site lab / outside labs. All expenses payable for transport of samples and conduction of tests shall be borne by the contractor.

16.0 VARIATION IN TAXES, DUTIES, LEVIES & IMPOSITION OF NEW TAXES ETC.

i) The bid price shall be inclusive of work contract tax / VAT/GST/ Labour Cess or any other tax levied on the transfer of property and goods involved in the “Works Contract” in accordance with the relevant Act in the State Act and rules made there under including amendments, if any.
The liability on account of such tax as per the rates of tax prevailing as on seven days prior to last date of bid submission shall be included in the price bid. In case of any variation in the rates of tax after this date, the same shall be paid / recovered from the contractor subject to the submission of documentary evidence and proof of having made the payment at the revised rate.

ii) The Bid Price shall also be inclusive of Service Tax, if applicable on Construction Services as per the rates prevailing as on seven (7) days prior to the last date of submission of tender (including abatement as applicable). In case of any variation in the rate of Service Tax, after this date, an equitable adjustment of the Contract Price shall be made to fully take into account any such change by addition / deduction to the Contract Price.

iii) If a new tax, duty or levy is imposed under statute or law in India after the date seven (7) days prior to the last date of submission of tender and the contractor becomes liable there under to pay and actually pays the said new tax, duty or levy for bonafide use on the works contracted, the same shall be reimbursed to the contractor against documentary evidence of proof of payment, provided that the amount thus claimed is not paid / payable under price variation provision of the Contract.

iv) The payment / reimbursement of statutory variations in the rates of tax and / or of new tax, duty or levy imposed under statute or law in India as per para (i), (ii) & (iii) above, would be restricted only to direct transaction between the EPI and the Contractor.

v) Rates shall remain firm till completion of entire works and shall be inclusive of all taxes, entry tax, duties, VAT/ WCT/GST, Labour Cess and other levies etc as applicable.

17. 0 FINAL BILL

The final bill will be submitted by the contractor within 90 days from the date of acceptance of completion of work accompanied by the following documents.

a) Interim Completion certificate issued by the Engineer-in-charge specifying the handing over of the work including list of inventories (fittings & fixtures).

b) Computerized stage wise payment schedule.

c) No claim certificate by the contractor.

d) No claim certificate from the sub agencies / vendors engaged by the contractor.

e) ‘As built’ drawings.

f) Periodical services and measurement books.
g) Drawings for layout of underground cables and details showing location of sluice valves, electric cable joints etc.

h) All operation and maintenance manuals.

i) All statutory approvals from various state / central govt. local bodies, if required for completion & handling over of the work as included in scope of contractor.

j) Manufacturer’s guarantee of various machines / equipments installed as part of works.

18.0 For dispatch of materials to site, equipment manufacturer / supplier shall mark consignee as self A/c Central University of Jammu (CUJ) through Engineering Projects (India) Ltd (EPI).

19.0 ROAD PERMIT

Road permit for transportation of goods across state border shall not be issued by CUJ / EPI and will have to be arranged by contractor on his own. Transit Insurance of the equipment shall be arranged by the contractor. Nothing extra shall be paid on this account.

20.0 Invoice should be raised by Contractor in the name of Engineering Projects (India) Ltd., at Project Office : H. No. 446, Sector–5, Channi Himmat, Jammu (J&K) on account of CUJ, Jammu with copy to EPI-PMD, NRO, New Delhi.

21.0 MOBILIZATION ADVANCE

Mobilization Advance at the interest rate of State Bank of India PLR plus (+) 2% maximum up to 10% of the contract value shall be paid to the contractor as per clause no 8.0 of GCC.

Contractor shall instruct the Bankers to send the Bank Guarantee in duly approved format directly to EPI under registered post AD.

22.0 THE CLAUSE NO. 69.1 (IV) - “ALTERATION IN SPECIFICATIONS” OF GCC STANDS MODIFIED AS UNDER

If the rates for the altered, additional or substituted work cannot be determined in the manner specified in sub-clauses 69.1 (i) to (iii) of GCC, then the Contractor shall, within 7 days of the date of receipt of order to carry out the work, inform the Engineer-in-Charge the rates which he intends to charge for such class of work, supported by analysis of the rate or rates claimed, and the Engineer-in-Charge shall determine the rate or rates on the basis of prevailing market rates of the material, Labour, T&P etc. plus 15% (Fifteen percent) to cover the Contractors supervision, overheads and profit and pay the Contractor accordingly. The opinion of the Engineer-in-charge as to the current market rates of materials and quantum of labour involved per unit of measurements will be final and binding on the Contractor.
However, the Engineer-in-Charge, by notice in writing, will be at liberty to cancel his order to carry out such class of work and arrange to carry it out in such manner, as he may consider advisable. But under no circumstances, the Contractor shall suspend the work on the plea of non-settlement of rates of items falling under the clause.

23.0 THE CLAUSE NO.72.1 (COMPENSATION FOR DELAY) OF GCC SHALL BE REPLACED AS UNDER

The Contractor shall ensure adequate progress during the execution of work according to the detailed Bar Chart / PERT chart so that the activities are completed in the period allowed in the completion schedule as given at S. No. 29.0 of ACC.

However, the Contractor shall also maintain monthly progress strictly in accordance with bar chart and / or detailed time schedule that will be worked out on the basis of completion schedule for various stages mentioned at clause no. 29.0 of ACC.

If the Contractor fails to maintain the above progress or to complete the work corresponding to S. No. 1 to 5 of completion schedule as given at clause no. 29.0 of ACC and clear the site on or before the contract or extended date of completion, he shall without prejudice to any other right or remedy of the EPI on account of such breach, pay as agreed compensation and not as penalty at the rate of half percent (1/2 %) per every week of delay of the entire value of contract.

The total amount of compensation payable by the contractor for delay in completion of the work corresponding to S.No.1 to 5 of completion schedule as per clause no. 29.0 of ACC shall not exceed 10% of the total contract value as awarded.

24.0 CLAUSE NO. 72.4.1 (TIME ESSENCE OF CONTRACT & EXTENSION FOR DELAY) OF GCC STANDS MODIFIED AS UNDER

As the completion time is the essence of the contract, Agency may require additional resources, men & machinery, which has to be considered while quoting.

Within 10 (Ten) days of date of Letter of Intent, the contractor shall submit a Time and Progress Chart (CPM/PERT/Quantified Bar Chart) and get it approved by the Engineer-in-Charge. The Chart shall be prepared in direct relation to the time stated in the contract documents for completion of items / scope of the works. It shall indicate the forecast (mile stones) of the dates of commencement and completion of various items trades, sections of the work and may be amended as necessary by agreement between the Engineer-in-Charge and the Contractor within the limitations of time imposed in the contract documents, to ensure good progress during the execution of the work. The approval by the Engineer-in-Charge of such programme including modifications made by the Engineer-in-Charge in the said programme shall not relieve the contractor of any of his duties or responsibilities under the contract. This is without prejudice to the right of Engineer-in-Charge to take action against the contractor as per terms and conditions of the agreement.
The physical report including photographs shall be submitted by the contractor on the prescribed format & the intervals (not later than a month) as decided by the Engineer-in-Charge. The compensation for delay as per clause 72.1 (revised as per ACC) shall be leviable in case the required progress is not achieved to meet the time deadlines of the completion period for execution of the complete work as per scope of work.

In case entire work is completed within the total time period of completion or extended period of completion allowed, the compensation for delay due to not achieving progress at intermediates stage, if any, shall be refunded without any interest charges.

25.0 PLANT AND MACHINERY

All plant & machinery required for execution of work shall have to be arranged by the contractor at his own cost. However, the contractor has to deploy following minimum plant & machinery in good condition at site immediately after award of work.

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<th>Description</th>
<th>Minimum Number Required</th>
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<td>1.</td>
<td>Total station for surveying work.</td>
<td>One</td>
</tr>
<tr>
<td>2.</td>
<td>Vibrators (Petrol / Electrical)</td>
<td>Six</td>
</tr>
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<td>3.</td>
<td>Needles of Vibrator</td>
<td>Twelve</td>
</tr>
<tr>
<td>4.</td>
<td>Excavator/Poclain</td>
<td>One</td>
</tr>
<tr>
<td>5.</td>
<td>Tipper / Dumper (3 cum.)</td>
<td>Two</td>
</tr>
<tr>
<td>6.</td>
<td>DG Set (63 KVA &amp; 125 KVA)</td>
<td>One Each</td>
</tr>
<tr>
<td>7.</td>
<td>Concrete Batching Plant (automatic-computerized) of minimum Capacity of 30 cum/hr.</td>
<td>One</td>
</tr>
<tr>
<td>8.</td>
<td>Conc. Pump of required capacity along with pipelines (Pipe length as per requirement )/ Boom Placer</td>
<td>One</td>
</tr>
<tr>
<td>9.</td>
<td>Transit Mixtures (3 Cum.)</td>
<td>Two</td>
</tr>
<tr>
<td>10.</td>
<td>Water Tanker</td>
<td>Two</td>
</tr>
<tr>
<td>11.</td>
<td>Mixture machine with weigh batcher 14/10 capacity</td>
<td>Two</td>
</tr>
<tr>
<td>12.</td>
<td>Tractor with trolley for transportation of material</td>
<td>One</td>
</tr>
<tr>
<td>13.</td>
<td>The agency shall provide sufficient area lighting for the safe execution of works during night hours through static / mobile arrangements.</td>
<td>As per requirement of site</td>
</tr>
<tr>
<td>14.</td>
<td>Laboratory equipments</td>
<td>As required</td>
</tr>
</tbody>
</table>

Note:

a) Any other equipment for site test as outlined in CPWD / BIS specification and as directed by the Engineer—in—charge.

b) The quantities of equipments mentioned above are indicative only and can be increased as per the requirement of quantum work OR as per the direction of Engineer-in-Charge. The above equipment list is indicative and not complete. The contractor has to deploy all the required equipment to complete all the works within stipulated specifications and time period as per contract documents.
c) The contractor will not be allowed to take out equipments from the site without the written permission of Engineer-in-charge.

d) In the event of breakdown of any equipment the contractor should immediately mobilize replacement of the said equipment.

26.0 CENTERING & SHUTTERING

26.1 Centering & shuttering works for columns shall be made out of laminated shuttering plywood of minimum 12mm thickness as per BIS, with angle iron frame. The staging system shall be got approved from the Engineer-in-charge. Scaffolding of latest materials/round steel pipes with couplers and brackets shall be used. Wooden planks, props, ballies etc are not permitted for use and steel plate shuttering is also not permitted.

26.2 The shuttering used for beam shall be of laminated shuttering plywood as per BIS. The support system shall be integrated with the slab. For slabs in case ply wood shutters is not used,( because of site or practical consideration) welded steel plates will be allowed to be placed in uniform pattern. The thickness of plates and pattern to be got approved from the Engineer-in-charge.

26.3 All joints in the shuttering i.e. plate to plate etc shall have to be sealed with adhesive / foam, to ensure water tightness of the form work.

26.4 All shuttering work for Architect features shall be with fiber glass moulds and the rate quoted by the contractor in the schedule of rate shall be inclusive of same.

26.5 All shuttering joints in the slab, beams and lintels etc. shall be treated with tape of required width to make it water tight and the rates quoted for centering shuttering work shall be all inclusive and nothing extra whatsoever shall be payable over and above the quoted price.

26.6 The shuttering shall be tightened by using runners, tie rods and bracings. No Ghughoo / welded system shall be allowed. Support shall be adequate and proper.

27.0 CONCRETING

27.1 The concreting shall be from batching plant installed at site.

27.2 Alternatively, the contractor may opt to use Ready Mixed Concrete (within 50km distance from the site of work) of repute after obtaining prior written approval from the Engineer-in-charge.

    Ready mix concrete brought from outside sources or produced at site shall have minimum quantity of cement as specified in BIS specifications and as per approved design mix

27.3 The batching plant of minimum capacity of 30cum./hr. with a least count of 0.5kg, drum type four load cells, computer compatible print out for each batch only shall be allowed.
27.4 The concreting shall be placed by concrete pumps of required capacity. Concreting by crane and buckets will be allowed in rare case with the prior approval of Engineer-in-charge.

27.5 The contractor shall provide construction joints only at the specified positions and as per BIS codes and the concreting for columns shall be floor to beam height in one lifts, and in case the concreting is to be done in two lifts the minimum height of first lift of columns shall be 2.4 meters.

27.6 The stone aggregate and sand of required zone shall be from the quarries as approved by Engineer-in-charge. The samples of the materials shall be got approved along with the mix design.

27.7 Plasticizers of the required specification and make shall only be permitted as per approved mix design.

27.8 The contractor shall provide all cut outs in RCC work in co-ordination with other agencies and as per instructions of Engineer-in-charge and nothing extra shall be payable. In case the same is not provided by the contractor the same shall be got done at their risk and cost.

27.9 To ensure proper cover, only factory made approved cover blocks will be used to avoid displacement of bars in any direction.

27.10 The steel bars of different diameter should be stored about 30-45 cm. above ground level or on concrete surface to avoid corrosion of steel. No extra payment shall be made on this account.

28.0 DESIGN MIX CONCRETE

28.1 Design mix concrete shall be used in the work for all structural members. For design mix, CPWD specification along with relevant IS codes shall be followed in general along with the specific provisions made herein.

28.2 All parameters shall be adopted for design mix as per latest relevant BIS code.

28.3 Approved admixtures conforming to latest relevant IS code shall be permitted to be used. The chloride content in the admixture shall satisfy the requirement of latest IS code. The total amount of chloride content in the admixture mixed concrete shall satisfy the requirement of latest IS code.

28.4 The concrete mix design with and without admixture will be carried out by the contractor through one of the following laboratories/ Test houses to be approved by Engineer-in-charge.

   a) IIT, Delhi / Roorkie
   b) CRRI, Delhi
28.5  In the event of all the above laboratories being unable to carry out the requisite
design/ testing, the contractor shall have to get the same done from any other
reputed laboratory with prior approval of the Engineer-in-charge.

28.6  The various ingredients for mix design/ laboratory tests shall be sent to the lab/test
houses through the Engineer-in-charge and the samples of such ingredients sent
shall be preserved at site by the department till completion of work or change in
Design mix whichever is earlier. The sample shall be taken from the approved
materials which are proposed to be used in the work.

28.7  The contractor shall submit the mix design report from approved laboratory for
approval of Engineer-in-charge within 45 days from the date of issue of letter of
acceptance of the tender. No concreting shall be done until the mix design is
approved.

28.8  The contractor shall make cubes of trial mixes as per approved mix design for all
grades of concrete in presence of the Engineer in charge using same ingredients as
adopted for design mix, prior to commencement of concreting and get them tested in
presence of Engineer-in-charge for 7 days and 28 days. For each design mix, a set
of six cubes shall be prepared from each of the three consecutive batches. Three
cubes from each set shall be tested at the age of 7 days and three cubes at the age
of 28 days. The cubes shall be made, cured, transported and tested strictly in
accordance with CPWD specifications. The average strength of nine cubes at the
age of 28 days shall exceed the specified target mean strength for which design mix
has been approved.

28.9  80% of the total tests shall be done at the laboratory established at site by the
contractor and remaining 20% in the approved laboratory as directed by Engineer-in-
Charge and the testing charges of the samples shall be borne by the contractor.

28.10 For each change of source or quality/ characteristic properties of the ingredients from
that approved & used in the concrete mix during the work, a fresh mix design shall
be got done by the contractor. Revised trial mix test shall be conducted at laboratory
established at site/ reputed Laboratory with prior approval of Engineer-in-charge and
shall be submitted by the contractor as per the direction of engineer-in-charge.

28.11 The cost of packaging, sealing, transportation, loading & unloading cost of all
samples-concrete /cubes/ steel/ other material etc and the testing charges for mix
design in all cases shall be borne by the contractor.
### 29.0 COMPLETION SCHEDULE

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Period from the date of Start</th>
<th>Cumulative Value as a percentage of total value of work to be completed till the end of period specified as under Column No. 2</th>
<th>Description of work to be completed during the period specified under column no. 2 (Milestone)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>From the date of start to the end of 1\textsuperscript{st} month.</td>
<td>25%</td>
<td>Completion of foundation upto plinth level.</td>
</tr>
<tr>
<td>2</td>
<td>From the start of 2\textsuperscript{nd} month to the end of 3\textsuperscript{rd} month.</td>
<td>40%</td>
<td>Completion of structure / brick work of all buildings.</td>
</tr>
<tr>
<td>3</td>
<td>From the start of 4\textsuperscript{th} month to the end of 4\textsuperscript{th} month.</td>
<td>55%</td>
<td>Completion of 50% flooring, plastering, internal services of electrical and start of other services.</td>
</tr>
<tr>
<td>4</td>
<td>From the start of 5\textsuperscript{th} month to the end of 5\textsuperscript{th} month.</td>
<td>80%</td>
<td>Completion of all civil, finishing, electrical, and plumbing &amp; other service (excluding fixtures).</td>
</tr>
<tr>
<td>5</td>
<td>From the start of 6\textsuperscript{th} month to the end of 6\textsuperscript{th} month.</td>
<td>100%</td>
<td>Completion of all works including fittings &amp; fixtures, testing &amp; handing over of all buildings &amp; services to CUJ.</td>
</tr>
</tbody>
</table>

**Note:** In case of mismatch in financial and physical progress as at col No. 3 & 4, above at any milestone stage, the financial progress shall be considered for levy of compensation of delay, if any, under clause No. 23 of ACC. All infrastructural development works shall be completed within the stipulated time frame.

### 30.0

The contractor shall comply with legal orders, directions and by laws of local bodies / authorities. The contractor shall give to the Municipality, Police, Local Bodies and concerned Governmental authorities all necessary notices relating to works that may be required under the law and obtain all requisite licenses, permissions for temporary obstructions, enclosures, collection and stacking of materials, etc. The contractor shall pay at his own cost all fees, taxes and charges that may be liable on account of these operations in executing the contract. Nothing extra shall be paid by EPI on this account.
The contractor shall be bound to follow the instructions and restrictions imposed by the administration / Police authorities on the working and / or movement of labour, materials etc. nothing extra shall be payable due to less / restricted working hours at site or any detours in movement of vehicles.

31.0 INSPECTION, TESTING AND ACCEPTANCE

31.1 TEST CERTIFICATE

All manufacturer’s certificates of test showing that the all equipments/ materials have been tested in accordance with the requirements of the relevant standard specification and the copy of the test certificate as well as standard shall be supplied free of cost to EPI/CUJ.

31.2 PERFORMANCE TEST

The contractor shall give performance tests of the entire installation (s) as per specifications and drawings before the work is finally accepted and nothing extra whatsoever shall be payable to the contractor for these performance tests.

After completion of installation, testing and commissioning of the complete equipments and HVAC System as per tender specifications, the Contractor shall, however, provide proper training to the Owner’s (CUJ) employees / representatives for operation and maintenance of equipments and HVAC System free of cost. The contractor shall issue a certificate that the equipments and HVAC System operator training is complete and contractor is fully satisfied with the operator's performance.

31.3 INITIAL INSPECTION AT MANUFACTURER’S WORK

The contractor shall submit the inspection & test plan for all the materials to be procured as per BOQ for approval from EPI/ CUJ. The contractor will be required to furnish such facilities as will be necessary for inspection of all equipments before dispatch at his or his associate’s works/ manufacturer’s works and also for witnessing such tests as per technical specifications at the works, if so required by CUJ/ EPI. The contractor shall furnish information for this purpose & will give sufficient notice regarding dates proposed for such tests to inspection agency.

31.4 INSPECTION DURING INSTALLATION AND FINAL INSPECTION

The contractor shall arrange for checking & testing and commissioning the installation as per technical specifications. Installation of equipments shall not be accepted until CUJ/ EPI is satisfied about its compliance with requirement of the specification in all respects. All instruments/ equipments/ HVAC system/ materials required for testing shall be the responsibility of the contractor. The final inspection of the installation and testing of all equipments and materials may be carried out by CUJ/ EPI. The taking over of all equipments after trial run shall be subject to removal of defects, if any, pointed out during the inspection.
The contractor shall arrange at his own cost for all tests, staff, fuel, POL & other consumables during trial run, commissioning & running in period up to the date of acceptance. Nothing extra shall be paid on this account.

The contractor shall prepare and submit records of all the tests pertaining HVAC system to be carried out during summer, monsoon and winter seasons.

31.5 RUNNING-IN-PERIOD

After satisfactory final inspection, the contractor shall demonstrate the trouble free running of the installation of equipments/ HVAC system for a period of not less than 30 days before EPI takes over. After the installation has operated for 30 days period without any breakdown or abnormal / unsatisfactory operation of any machinery during this period, the equipments/ HVAC System shall be deemed to have run trouble-free. The contractor should include one year of free running maintenance after completion of 30 days of trouble free running including replacement of defective parts etc. at his own cost.

The contractor shall arrange at his own cost for all staff, fuel, POL, refrigerant gas, and other consumables during Trial run, Commissioning and Running-in-Period upto the date of acceptance. The contractor shall also make his own arrangements for power required during construction, fabrication, erection & trial run etc. Nothing extra shall be paid on this account.

31.6 SEASONAL TESTS FOR HVAC SYSTEM

The contractor shall carryout three Seasonal Tests for summer, Monsoon & Winter as soon as the ambient / outside conditions are suitable for that. All the three seasonal tests (Summer, Monsoon & Winter) must be completed successfully during the Defects Liability Period of 12 months, otherwise Defects Liability Period will get extended till all the three seasonal tests are successfully completed. Nothing extra shall be paid on this account.

32.0 DATE OF ACCEPTANCE

Subject to the guarantee Clause date of taking over the installation for the beneficial use by CUJ shall be the date of acceptance. Any undue wear and tear of component during the “Testing Period” shall be made good by the contractor free of charge.

33.0 AFTER SALES SERVICES

Contractor shall ensure adequate and prompt after sales services in the form of maintenance personnel and spares as and when required. Particular attention shall be taken to ensure that spares are easily available during the normal course of life after installation.

The contractor shall make suitable arrangement to provide onsite service at Jammu on a notice of three days.
34.0 GUARANTEE

The contractor shall guarantee that the all the materials and workmanship of works & equipments executed / installed by him, under these specifications shall be new and first class in every respect. He will make good any defect within 24 hours, which may develop within 12 months from the date of handing over of the installation after testing and commissioning without any extra cost to EPI / CUJ.

All equipments, materials and systems shall be guaranteed for a period of 12 months from the date of taking over the installation by CUJ / EPI, against unsatisfactory performance and / or break down due to defective design, workmanship or material. The equipments / components / software or any part thereof, so found defective, during guarantee period shall be forthwith repaired or replaced free of cost, to the satisfaction of the Engineer-In-Charge. In case it is felt by CUJ / EPI that undue delay is being caused by the contractor in doing this, the same will be got done by CUJ/ EPI at the risk and cost of the contractor. The decision of the Engineer-In-Charge in this regard shall be final.

The contractor shall also guarantee the performance of individual equipment.

35.0 INSURANCE UNDER WORKMEN COMPENSATION ACT

The clause '18.0' (Insurance Under WCA) at page 22 of General Conditions of Contract (GCC shall be replaced and read as under:

Contractor is required to take insurance cover under the workmen compensation Act, 1923 amended from time to time from an approved insurance company and pay premium charges thereof. Wherever required by EPI, the contractor shall produce the policy or the policies of Insurance and the receipt of payment of current premium. In the event of an accident, any workmen employed by the contractor for execution of the works, suffers an injury or death and is to be compensated under the provisions sub-section (1) of section 12, of the workmen’s Compensation Act, 1923 by the contractor and if the contractor fails to compensate, the EPI / CUJ shall be entitled to recover from the contractor the amount of the compensation so paid, without prejudice to the rights of the EPI / CUJ under section 12, sub-section (2), of the said Act.

EPI / CUJ shall be at liberty to recover such amount or any part thereof by deducting it from the security deposit or from any sum due to the Contractor whether under this contract or otherwise. EPI / CUJ shall not be bound to contest any claim made against it under sub-section (1) Section 12, of the said Act, except security for all cost for which EPI / CUJ might become liable in consequence of contesting such claim.

36.0 INSURANCE OF WORKS

The Insurance coverage as stipulated in General Conditions of Contract (GCC) clause no. 17 (Insurance of works), clause no. 18 (Insurance under WCA) and clause no. 19 (Third Party Insurance) shall be in the joint name of CUJ, EPI and the Contractor for the contract period and 12 months after Successful completion / handling over of work. The Insurance coverage shall be on the total value of work awarded to contractor by EPI.
37.0 INDEMNITY AGAINST PATENT RIGHTS

The following Para shall be added to clause No. 20.0 of General Conditions of Contract as under:

The Indemnity against Patent rights shall be in the Joint Name of CUJ and EPI.

38.0 CLAUSE NO. 35.0 OF GCC (SECURED ADVANCE AGAINST NON-PERISHABLE MATERIALS) STANDS DELETED.

39.0 PERMITS AND INSPECTIONS

The contractor shall obtain all necessary permits from local bodies, provincial or central authorities and shall make arrangement for inspection and tests etc. as required at his own cost.

The contractor shall have to make his own arrangements for getting the permission for plying trucks or any Plant & Equipment for execution of works from the Police Department/ Govt. authorities at his own cost. No excuse as to delay in work due to non-availability of permission shall be entertained.

40.0 LICENSES

The contractor shall arrange for obtaining the license and clearances for the operation. (If required) from the local authorities and statutory bodies at his own cost & nothing extra shall be payable. Certification of various equipments / installations from statutory bodies other agencies as required as per technical specifications, shall be arranged by contractor at his own cost before handing over.

41.0 The work shall be carried out in accordance with the drawings/documents approved by the EPI / CUJ. Before the commencement of any item of work, the contractor shall correlate all the relevant architectural and structural drawings issued for the work and satisfy himself that the information available there from is complete and unambiguous. The discrepancy, if any, shall be brought to the notice of Engineer-In-Charge before carrying out surveying work. The contractor alone shall be responsible for any loss or damage occurring by the commencement of work on the basis of any erroneous and / or incomplete information. Nothing extra shall be paid on this account.

42.0 The contractor shall be bound to sign the site order book as and when required by Engineer-In-Charge at Site and carry out compliance of instruction promptly to the satisfaction of Engineer-In-Charge.

43.0 Bill of Quantities shall be read in conjunction with the specifications and requirement described in tender documents, Instructions to tenderers, General conditions of contract, Additional conditions of contract, Technical specifications, Drawings, Schedules, and Annexure & Addendum etc. to tender document.
General directions and description of work and materials are not necessarily repeated or summarized in the Bill of quantities. Reference to the relevant sections of the contract document shall be made by the contractor before entering rates or prices against each item in the Bill of Quantities.

44.0 If the headquarters of the successful contractor are elsewhere other than in Jammu, he shall ensure to have a duly authorized representative in Jammu from the commencement of the work until the work/ system is taken over by CUJ. Such agent shall be authorized to act on behalf of the successful contractor to accept service of notice of contract and to agree to extras, omissions and varied item of works and rates for the same. Such agent shall maintain on his staff a qualified engineer approved by the engineer in-charge and such office personnel as may be required for the efficient execution of the works. Any notice under the contract shall be deemed to have been served on the successful contractor if served upon such agent or sent by registered letter to his address. Such agent shall not be changed and shall not leave during duration of contract unless the consent of the engineer in-charge shall have been previously obtained. If the engineer in-charge orders to successful contractor to carry out any rectification under the terms of contract after the work is complete and during the defects liability period the successful contractor shall carry the same without any extra cost.

45.0 SITE ENGINEER OF CONTRACTOR

The Contractor shall employ at his cost the adequate number of technical staff during the execution of this work depending upon the requirement of work. For this purpose the number of staff to be deployed, their qualification, experience as decided by EPI shall be final and binding on Contractor. The Contractor shall not be entitled for any extra payment in this regard. The technical staff should be deployed on full time basis & available at Site, whenever required by EPI to take instructions.

However, Minimum qualifications and experience required for principal technical rep. and other minimum technical staff other than supervisor is given below:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Qualification</th>
<th>No.</th>
<th>Minimum Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Graduate Civil Engineer/Engineer – As a Principal Technical Representative/Project-in-charge</td>
<td>1</td>
<td>Atleast 15 year experience in execution of reputed project of multi-storey residential / non residential buildings / institutional buildings including external development work etc.</td>
</tr>
<tr>
<td>2.</td>
<td>Graduate Civil Engineer/Engineer – As a Project Manager</td>
<td>1</td>
<td>Atleast 10 year experience in execution of reputed project of multi-storey residential / non residential buildings / institute etc.</td>
</tr>
<tr>
<td>3.</td>
<td>Diploma Engineer (Civil) as a Site Engineer for execution of civil work.</td>
<td>1</td>
<td>Minimum 5 years experience in execution of multi-storey residential / non residential buildings / institute etc.</td>
</tr>
</tbody>
</table>
4. Graduate/Diploma (Electrical) as a Site Engineer for execution of electrical work. | 1 | Atleast 5-8 year experience in execution of electrical work in multi-storey residential / non residential buildings / institute etc.

5. Graduate Civil Engineer for QA & QC work as an Incharge of Site Laboratory. | 1 | Atleast 8-10 year relevant experience in QC/QA work of institutional & residential building.

6. Surveyor with Diploma in Surveying for Site surveying work. | 1 | Minimum 5 years experience in Surveying work of hilly terrain using total station.

If Contractor fails to deploy minimum Technical staff as mentioned above, recovery on account of non-deployment of each Technical staff shall be made from subsequent RA Bills as under:

<table>
<thead>
<tr>
<th>S. No</th>
<th>Experience</th>
<th>Graduate/degree holder (INR P.M)</th>
<th>Diploma holder (INR P.M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15 years</td>
<td>80,000</td>
<td>50,000</td>
</tr>
<tr>
<td>2</td>
<td>10 years</td>
<td>70,000</td>
<td>45,000</td>
</tr>
<tr>
<td>3</td>
<td>8-10 years</td>
<td>60,000</td>
<td>40,000</td>
</tr>
<tr>
<td>4</td>
<td>5-8 years</td>
<td>50,000</td>
<td>35,000</td>
</tr>
<tr>
<td>5</td>
<td>5 years</td>
<td>45,000</td>
<td>30,000</td>
</tr>
<tr>
<td>6</td>
<td>Without experience</td>
<td>30,000</td>
<td>-----------</td>
</tr>
</tbody>
</table>

46.0 COMPLETION AND TAKING OVER

As soon as the project is finally completed, the contractor shall inform EPI and EPI shall in turn inform to Central University of Jammu (CUJ). CUJ shall nominate a committee / officers for checking / verifications of completed work as per the scope of work for final taking over the project.

47.0 It will be the sole responsibility of contractor to obtain all statutory approvals and completion clearance from the all relevant statutory bodies for all other services as included in the scope of contract etc. from the concerned department as required within the stipulated time frame. Liaison work on behalf of EPI with the local bodies will also have to be done by the contractor. Nothing extra shall be payable to contractor on this account. No claim whatsoever in this regard shall be entertained.

48.0 The contractor shall make necessary safety arrangement at site including as mentioned in GCC and indemnify EPI against any consequence of accident at site.

49.0 EPI is awarding agency in respect of this Contract on behalf of CUJ. In case M/s. EPI cease to be PMC, the right and responsibility etc. of EPI in the Contract shall get transferred to CUJ or their nominated agency shall operate this Contract.

50.0 Deduction (non-refundable) at the rate of 1% or at the rates applicable from time to time in the state of J&K from gross amount of each running bill and from final dues of contractor shall be made towards provision for workers “Welfare Cess Act 1996”.

Signature of Contractor: 20

EPI
51.0 Contractor will be responsible to arrange day to day housekeeping as required at site as per instruction of Engineer in charge.

52.0 ISO COMPLIANCE


53.0 FACILITIES

The Clause No. 28.3 (Furnished office accommodation & mobility and communication) of GCC shall be replaced as under:

The agency at its own cost shall provide suitable office space equipped with necessary furniture with necessary facilities like purified drinking water, electricity, Office Boy, and other transport facilities etc. to EPI Site Staff.

The Contractor shall provide ‘Sign Board(s)’ as per design approved by EPI and/or Client.

54.0 The Contractor shall furnish details whether they are covered under micro, small and Medium Enterprise Development Act 2006. If yes, clearly indicate under which category they are covered along with documentary evidence. This information is required to be furnished along with the bid.

55.0 Clause no. 76.1 (Arbitration) of GCC stands deleted.

56.0 GENERAL CONDITION OF “GRIHA” REQUIREMENT FOR CUJ PROJECT

The CUJ intends to develop green complex & obtain “GOLD” rating of “GRIHA” for the proposed facilities included in the project. Bidder to familiarize the requirements and note that all requirements of “GRIHA” pertaining to construction for achieving the above targeted rating. No extra payment shall be made on this account.

The contractor shall develop and implement spill prevention plan and erosion & sedimentation control plan and adopt proper staging during construction in line with “GRIHA” requirement and as per the instructions of Engineer – in – Charge. The contractor shall also adopt necessary measures for proper stabilization of soil in line with “GRIHA” requirements.

The project shall generate the least amount of waste possible and assimilate those processes that ensure the generation of waste as little as possible due to error, poor planning, breakage, mishandling, contamination or other defects shall be deployed.

The contractor shall designate specific areas as per directions of Engineer – in – Charge at construction site for segregated or mingled collection of recycled materials as consistent with requirements for acceptance by designated facilities.
REQUIREMENTS OF “GRIHA”

- Handling of materials & men by ensuring that the ground profile is least disturbed.
- Develop and implement spill prevention plan and erosion & sedimentation control plan.
- Segregation & proper record keeping of “disposal of all construction waste materials like rocks, empty cement bags, plastic containers, scrap steel, sanitary waste” etc.
- Proper housekeeping at site.
- Ensuring efficient use of water during construction.
- Minimizing air pollution during construction and arranging suitable water sprinkling arrangement at site.
- Control on erosion of soil during construction, construction of sedimentation tank and implement spill prevention plan.
- Implementation of HSE (Health, Safety and Environment) procedures & policies effectively.
- Ensuring proper staging / scaffolding during construction.
- Effective implementation of labour welfare measures / policies including well ventilated and hygienic labour camps with adequate lighting, water supply & sanitary arrangements.
- Submission of monthly report detailing compliance to the “GRIHA” norms and attaching the data and photographs.

56.1 EROSION & SEDIMENTATION CONTROL

It is required to prevent soil erosion through storm water and wind, both during construction and post-development. It needs interfacing of architect and the builder. Measures to be adopted include temporary landscaping, permanent seeding, mulching etc. The plan shall meet the following objectives.

- Prevent loss of soil during construction by storm water runoff and/or wind erosion, including protecting topsoil (fertile soil) by stockpiling for reuse.

The implementing agency should take steps to protect the top soil during construction, by way of storing and reusing it within the site. The existing landscape is to be retained to the maximum possible extent.

- Temporary landscaping, if required, to prevent the top soil erosion can be done by planting fast growing plants.
- Undeveloped areas within the site should not be disturbed and be protected with permanent landscaping before the start of construction, wherever possible.
- Prevent sedimentation of storm sewer or receiving streams.
- Prevent polluting the air with dust and particulate matter.

Site Sedimentation and Erosion plan should be as per practices National Building Codes of India (NBC) Part 10, Section 1, Chapter 4 – Protection of landscape during construction.
**Actions required by the contractor:**

- Prepare erosion and sedimentation control plan as described above.
- Take photographs of the existing site conditions.
- During excavation or site filling activities, Top soil should be stripped to a depth of 200mm from areas occupied by buildings, roads and external services. Top soil is rich in nutrient so it shall be stockpiled to a height of 400mm at the designated area. Protect the topsoil either by mulching, temporary landscaping or covering it with some plastic cover. The same soil shall be applied during plantation of vegetation and can also be used as a finished grade for planting areas.
- Watering the Vehicle tyres before coming out of the site so that the tyre does not carry soil along with it and pollute the surrounding areas.
- Provide paved areas wherever possible for the vehicular circulation path inside the site.
- Photographs of the site when the plan is being implemented.

**56.2 DUST EMISSIONS CONTROL**

The following methods shall be used by Contractor to prevent conditions conducive to dust generation and suppress dust should it occur.

- Adjacent paved areas and roads used for construction traffic shall be maintained free of tracked soil or fill materials. At minimum, paved traffic areas, driveways, sidewalks, and streets shall be cleaned on a daily basis by wet sweeping and/or washing. More frequent cleaning shall be provided as necessary. Adjacent paved areas and roads shall be left clean at the end of each day.

- Exposed excavations, disturbed ground surfaces, and unpaved traffic areas shall be maintained in a moist condition.

- During non-working hours, the Site should be left in a condition that will prevent dust from being generated. At the end of each work day, disturbed areas shall be wetted down and security fencing shall be installed and inspected to prevent access and additional disturbance.

- Provide temporary cover and daily maintenance for soil or fill stockpiles and keep active surfaces moist.

- A temporary decontamination pad and/or a stabilized construction entrance shall be provided at active site entrance/egress locations to keep adjacent paved areas clean.

- Soil loaded into transport vehicles for offsite disposal will be covered with continuous heavy duty plastic or other covering to minimize emissions to the atmosphere. The covering will be in good condition, joined at the seams, and securely anchored to minimize headspace where vapors may accumulate.
• **Rods**: All onsite traffic shall be restricted to specific designated roads. Off-road travel shall only be authorized on a case-by-case basis. Traffic speed shall also be restricted to an appropriate level not exceeding 20 km/hour on all designated roads. All designated roads shall be considered as high potential dust source areas, and as such, will be a priority for dust controls utilizing water and/or gravel.

56.3 **CONSTRUCTION WASTE MANAGEMENT**

Develop and implement Construction Waste Management Plan that should include the list of various items that can either be reused during construction or recycled. Typical items may include steel, ductwork, Glass, Steel, Aluminium, False roof materials, wood, jute bags, containers, paperboard & plastic used in packing, etc. The plan should also include where these materials will be sent to and the mode of transportation. By documenting measures implemented at site, the project will qualify for two points. The contractor has to ensure that 100% by weight or volume of the construction debris is recycled or reused and ultimately diverted from the landfill.

**Actions required by the contractor:**

Tabulate the total waste material, quantities diverted and the means by which diverted in the template attached.

- Earmark dedicated place within the site for storing & sorting construction wastes.
- Provide waste skips
- Receipts of sale, and donation should be collected and submitted to SSG.
- Gate passes with the weight noted should be provided to the haulers and later on submitted to SSG.
- Photographs of the material being reused on site and the waste materials being managed on the site should be taken and submitted.
- The unit for calculations should remain consistent throughout the documentation i.e. the percentages are calculated either by weight or by volume. Quantity of waste diverted in tons or cubic yards.

56.4 **Construction Indoor Air Quality Management Plan, During Construction**

Develop and implement an Indoor Air Quality (IAQ) Management Plan for the construction and pre-occupancy phases of the building as follows:

- During construction meet or exceed the minimum requirements of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA), IAQ Guideline for Occupied Buildings under Construction, 1995, Chapter 3.
- Protect stored onsite or installed absorptive materials from moisture damage.
- If air handlers must be used during construction, filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 must be used at each return air grill, as determined by ASHRAE 52.2-2004.
Additional Conditions of Contract
Engineering Projects (India) Limited

Actions required by the contractor:

- Develop Construction IAQ Management plan to include the following areas as per SMACNA guidelines:
  - Source Control
  - Scheduling
  - Pathway Interruption
  - Housekeeping
  - HVAC Protection
- Ensure implementation of IAQ measures on site during construction.
- Take photographs of the implemented measures
- Provide required documentation to Green building Consultant for “GRIHA” documentation

56.5 BUILDING MATERIALS

Hereunder are the SUSTAINABILITY CRITERIA’S related to the building materials (civil and interiors)

i. Materials with Recycled Content
ii. Regional/ Local Materials
iii. Certified Wood
iv. Rapidly Renewable Materials
v. Low Emitting Materials
vi. Energy Efficiency

MATERIALS WITH RECYCLED CONTENT, 10%

Use materials with recycled content such that recycled content constitute minimum 10% of the total value of the building materials in the project.

Recycled content materials are building products that include components that have recycled content and are processed off-site. Post-consumer recycled content is consumer waste that has become a raw material for another product. It originates from products that have served a useful purpose in the consumer market. Post-industrial/Pre-consumer recycled content products are those that contain waste from industrial processes that has been traded through the marketplace. For instance, a composite board manufacturer may purchase sawdust from a lumber mill or waste straw from a wheat farm.

The Value of the recycled content portion of a material or furnishing shall be determined by dividing the weight of recycled content in the item by the total weight of all materials in the item, then multiplying the resulting percentage by the total value of the item. Typically materials would include flyash cement & blocks, rerolled steel, Aluminum frame, wood from wood waste, tiles, false ceiling, Glass, Tiles, etc.

Typical materials with High Recycled Content available in the market are:
### REGIONAL/ LOCAL MATERIALS

1. **20% Manufactured Locally**

   Use a minimum of 20% of the building materials and products that are manufactured regionally within a radius of 800 Kms from the project site. Manufacturing refers to the final assembly of components into the building product that is furnished and installed by the tradesmen.

2. **50% Extracted Locally**

   Of the regionally manufactured materials mentioned above, use a minimum of 50% of the building materials and products that are extracted, harvested or recovered (as well as manufactured) regionally within a radius of 800 Kms from the project site.

### LOW EMITTING MATERIALS (Adhesive, Sealants, Paints and Coatings)

All adhesives, sealants, paints and coatings used on the interior of the building (defined as inside of the weatherproofing system and applied on-site) shall comply with the requirements as mentioned in the tables below.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Description</th>
<th>Maximum Allowable VOC Limit (g/l less water)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>ADHESIVES</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>i) Architectural Applications</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Indoor Carpet Adhesives</td>
<td>50</td>
</tr>
<tr>
<td>2.</td>
<td>Carpet Pad Adhesives</td>
<td>50</td>
</tr>
<tr>
<td>3.</td>
<td>Wood floor Adhesive</td>
<td>100</td>
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<tr>
<td>4.</td>
<td>Rubber floor Adhesive</td>
<td>60</td>
</tr>
<tr>
<td>5.</td>
<td>Ceramic Tile Adhesive</td>
<td>65</td>
</tr>
<tr>
<td>6.</td>
<td>VCT and Asphalt Adhesive</td>
<td>50</td>
</tr>
<tr>
<td>7.</td>
<td>Dry wall and panel Adhesive</td>
<td>50</td>
</tr>
<tr>
<td>8.</td>
<td>Structural Glazing adhesive</td>
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</tr>
<tr>
<td>9.</td>
<td>Multipurpose Construction Adhesive</td>
<td>70</td>
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<tr>
<td></td>
<td>ii) Specialty Application</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>PVC Welding</td>
<td>510</td>
</tr>
<tr>
<td>2.</td>
<td>Top &amp; Trim Adhesive</td>
<td>250</td>
</tr>
<tr>
<td>3.</td>
<td>Contact Adhesive</td>
<td>80</td>
</tr>
<tr>
<td>4.</td>
<td>Special Purpose Contact</td>
<td>250</td>
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iii) **Substrate Specific Application**

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<th>Substrate Specific Application</th>
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<tbody>
<tr>
<td>1.</td>
<td>Metal to Metal</td>
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<tr>
<td>2.</td>
<td>Plastic foams</td>
<td>50</td>
</tr>
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<td>3.</td>
<td>Porous material (except wood)</td>
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</tr>
<tr>
<td>4.</td>
<td>Wood</td>
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</tr>
<tr>
<td>5.</td>
<td>Fibre Glass</td>
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**B Sealants**

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<tr>
<th></th>
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<tr>
<td>2.</td>
<td>Top &amp; Trim Adhesive</td>
<td>300</td>
</tr>
<tr>
<td>3.</td>
<td>Contact Adhesive</td>
<td>250</td>
</tr>
<tr>
<td>4.</td>
<td>Special Purpose Contact Adhesive</td>
<td>420</td>
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</tbody>
</table>

**C Paints**

<table>
<thead>
<tr>
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<th>Paints</th>
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<tbody>
<tr>
<td>1.</td>
<td>Non-flat</td>
<td>150 g/L</td>
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<tr>
<td>2.</td>
<td>Flat (Mat)</td>
<td>50 g/L</td>
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<tr>
<td>3.</td>
<td>Anti-corrosive/anti-rust</td>
<td>250 g/L</td>
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</table>

**D Coatings**

i) **Clear wood finishes**

<table>
<thead>
<tr>
<th></th>
<th>Coatings</th>
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<tbody>
<tr>
<td>1.</td>
<td>Varnish</td>
<td>350 g/L</td>
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<td>2.</td>
<td>Lacquer</td>
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<td>3.</td>
<td>Floor Coatings</td>
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<tr>
<td>4.</td>
<td>Stains</td>
<td>250 g/L</td>
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<tr>
<td>5.</td>
<td>Sealers</td>
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<tr>
<td>6.</td>
<td>Waterproofing sealers</td>
<td>250 g/L</td>
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<tr>
<td>7.</td>
<td>Sanding sealer</td>
<td>275 g/L</td>
</tr>
<tr>
<td>8.</td>
<td>Other sealer</td>
<td>200 g/L</td>
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</tbody>
</table>

**LOW EMITTING MATERIALS (Carpet)**

To reduce the quantity of indoor air contaminants that are odorous, potentially irritating and harmful to the comfort and well being of installers and occupants. Carpet systems and carpet cushion installed must meet or exceed the requirements of the Carpet and Rug Institute’s Green Label Indoor Air Quality Test Program. All carpet adhesive shall meet the requirements of EQ Credit 4.1: VOC limit of 50 g/l.

**57.0 FACILITIES TO BE PROVIDED AT SITE FOR LABOUR WELFARE**

All facilities to be provided him at site for fulfilling all GRIHA & statutory labour welfare schemes are included in contractor’s scope which shall include the following but not limited to the same.

- Separate provision / rooms for First Aid Centre & Reset room and for the safety officer, safety supervisors and other personnel to be engaged by the contractor for H.S.E aspects of the project.
- Erecting sufficient numbers of Urinals, WC’s, drinking water, water supply and sanitary arrangements to the supervisory personnel and workmen engaged by them.
- Canteen facility to workmen engaged by the contractor.
- Treatment of waste from contractor’s toilets to meet the requirements of “GRIHA”.

The contractor shall deploy an experienced & qualified person exclusively for implementation of “GRIHA” requirements for the entire contract period.

...............
TECHNICAL SPECIFICATIONS

FOR

CONSTRUCTION OF ASSISTANT PROFESSOR QUARTERS

FOR

CENTRAL UNIVERSITY OF JAMMU

AT

VILLAGE BAGLA, DISTT. SAMBA (J &K)
1.0 GENERAL

1.1 The work under the contract shall be carried out in accordance with the schedule of work, the particular specifications drawings forming part of this tender document, and the general conditions and other provisions of the tender.

1.2 The work in general shall be carried out as per latest CPWD specifications New Delhi for Civil Works, Internal Electrical works and Fire fighting (updated with correction slips issued up to last date of submission of tender) unless otherwise specified in the nomenclature of the individual item or in the particular specifications of concerned items of works.

1.3 For items not covered under latest CPWD specification, for (Civil Works) / latest CPWD specification for Electrical Works, Fire fighting works etc. and in particular specification or nomenclature of the individual item as above, the work shall be done as per latest relevant BIS codes of practice and DIN or IEC standards.

1.4 In case specifications are not covered under Para 11.1 & 11.2 above the work shall be carried out as per the provisions of technical specification.

1.5 In case of non availability of any specification in the above paras or any overlapping provisions, non-clarity on any issue, applicability of particular provision out of above, shall be decided by Engineer-in-Charge whose decision shall be final & binding on the contractor.

1.6 The contractor is responsible for executing and completing the work in accordance with the specified standards and specification and as per requirements of GRIHA V ratings. Construction quality control is intended to provide a comprehensive common and consistent framework of quality control which is comprised of two main elements.

- Testing
- Inspection

1.7 The contractor shall be responsible for the types of test to be carried out, frequency of testing and stage of testing as directed by Engineer-in-charge or as stipulated in Indian Standards / CPWD Specifications for relevant works. The cost of all these tests shall deemed to be included in the item rates quoted by the contractor.

All test samples should be preserved, with proper identification, test log reference, test date and other applicable information. These samples must be stored on site by the contractor. In addition to tests performed on site, the contractor is responsible for specialized tests which are performed by manufacturers or third parties during the manufacturing of various materials and equipment components, to be incorporated in the works.
SECTION –A - TECHNICAL SPECIFICATIONS FOR CIVIL WORK

PREAMBLE

These technical specifications shall be read in conjunction with the various other documents forming the contract, namely Notice Inviting Tender & Instructions to Tenderers, Conditions of Contract, Special Conditions of Contract, Bill of Quantities and other related documents, together with any addendum issued thereto.

Absence of terms such as providing, supplying, laying, installing, fixing etc. in the description does not even remotely suggest that the contractor is absolved of such providing, supplying etc. unless an explicit stipulation is made in this contract. The owner shall bear no costs of materials, equipment’s duties, taxes, royalties etc.

In addition to the general obligation of the Contractor during defect liability period, the Contractor shall guarantee successful performance of waterproofing treatments for a period of ten years from the certified date of completion of the work. The Engineer shall prescribe the form and the manner of executing such guarantees. The Contractor hereby conforms that there is nothing in the items/specifications (or a shortcoming therein) as will prevent such successful performance. The work shall be executed through approved specialists experienced in the respective trades.

The classification of various items of work for purpose of measurements and payments shall be as per bills of quantities (BOQ). Except where distinguished by the BOQ, the rates apply to all heights, depths, sizes, shapes and locations. They also cater for all cuts and wastes.

The specifications may have been divided in different sections/sub-head for convenience only. They do not restrict any cross-reference. The Contractor shall take in to account inter-relations between various parts of works/trades. No claim shall be entertained on basis of compartment interpretations.

The payments for excavation shall be made assuming a vertical cut at the end of PCC under the foundations. The bidder should build the cost of such extra excavations in his bid including any shoring, strutting, etc. for stabilizing and safety of the sides of excavation.

The Contractor shall be required to submit and take approval from the Engineer-in-Charge/Consultant of shop drawings of the items of work specified in the specifications or as directed from time to time. No extra payment shall be made for the same. Shop drawings shall be in metric units and shall be prepared in a format approved by the engineer.

The Contractor shall prepare and submit as-built drawings by way of making modifications/changes carried out with respect to the construction drawings issued prior to the construction of respective elements. These will be then incorporated by the respective Consultant/agency in to their drawings for maintaining necessary records for the owner.

No walls, terraces shall be cut for making any opening after waterproofing has been done without approval of the Engineer. Cutting of waterproofing when authorized by the Engineer in writing shall be done very carefully so that no other portion of the waterproofing is damaged. On completion of the work at such places, the waterproofing membrane shall be made good and ensured that the opening/cutting is made fully waterproof as per specifications and details of waterproofing approved by the Engineer at no extra cost. No structural member shall be cut or chased without the written permission of the Engineer.

All materials intended to be used at site shall be tested prior to its use in an approved manner.
A list of tests including frequency of tests on construction materials is included in the special specifications. Cost of all such tests and any other tests felt necessary by the Engineer shall be deemed to be included in the price of respective materials quoted by the Contractor. Any defective materials brought to site shall be returned without any extra cost for the same.

Performance tests shall be carried out as the discretion of the Engineer on all/any items, of work as directed by the Engineer. Should any item shall fail to pass the tests, the Contractor shall be given opportunity to take corrective measures and have the same retested to the satisfaction of the Engineer, he may at his sole discretion order dismantling of the whole or part of the works done and order the Contractor to reconstruct the same. The cost of all these operations and materials shall be borne by the Contractor without any extra claim.

The Contractor may make a special note of the strictness of the concrete mix to be adopted in items of maximum water-cement ratio, minimum slump, control of total chloride and sulphate contents, use of admixtures etc.

Minimum cement contents are given purely from durability point of view. Larger contents shall have to be provided if demanded by mix design.

Provision of cement slurry to create bond between plain/reinforced concrete surface and subsequent applied finishes (floor, plaster, dado, skirting etc.) shall not be paid extra.

Mix design using smaller aggregate of 10mm down shall also be done in advance for the use in junction having congested reinforcement.

All full-fledged laboratories shall be established at site to start of construction and shall also stock all relevant codes as per the requirements of the special specifications.

Procedure of mixing the admixtures shall be strictly as per manufactures recommendations if not otherwise directed by the Engineer.

The batching plant for all concrete shall be used. Alternatively, use of ready mix concrete from an approved source shall be permitted. Concrete shall be transported using concrete pumps of adequate capacity including necessary stand by.

All the water tanks and other liquid retaining concrete structures shall undergo hydro-testing as per special specifications.

Special benches shall be provided at site for stacking reinforcement bars of different sizes as per the specifications.

Form work for beams of RCC areas shall be designed in such a way that the form work of the adjacent slabs can be removed without disturbing the props/supports of the beams.

Wherever there are tension/suspended concrete members, which are suspended from upper level structure members, the shuttering/scaffolding of such members at lower level shall have to be kept in place till upper level supporting members gain minimum required strength. Cost of such larger durations of keeping in place the shuttering/scaffolding shall be deemed to be included in the price quoted for respective structural members.

In the mobilization period, the contractor shall carry out expeditiously and without delaying the following works

• Material testing and mix design of concrete as contemplated in the specifications.
• Setting up of full-fledged site laboratory as per the requirement of these specifications.

Tech. Specification - 4
• Any other pre-requisite items required for final execution.

The specifications for market rate items to be executed under this contract are enclosed.

Items, which are not covered under the specifications, shall be executed; as per latest CPWD
specification and relevant IS codes or with specifications under the direction of engineer in
charge.

Scope of Work

The work to be carried under this contract shall consist of various items as per description of
works contained in the bill of quantities. Any discrepancy between the details given in bill of
quantities and that provided in technical specifications of the corresponding items, the
provisions of the bill of the quantities shall take precedence.

The item rates quoted by the contractor shall, unless otherwise specified also include
compliance with/supply of the following:

• General work such as setting out, clearance of site before setting out and clearance
  after completion
• A detailed program for the construction and completion of works (using CPM/PERT
  techniques) including updating of all such activities on the basis of decisions taken at
  the periodic site review meetings as directed by the engineer in charge.
• Samples of various materials proposed to be used on the work for conducting tests
  there on is required as per the provisions of the contract.
• Design of mixes as per relevant clauses of the specifications given proportions of
  ingredients, source of aggregates and binder along with accompanying trial mixes to be
  submitted to the Engineer-in-Charge for his approval before use on the works.
• Setting of field-testing laboratory with all required apparatus and staffs for conducting
day-to-day quality control tests.
• Any other item of work which is not specifically provided in the Bill of Quantities but
  which is necessary for complying with the provisions of the contract.

General

• The works will be executed as indicated in the nomenclature of each item and technical
  specifications as given hereunder as made applicable to this contract.
• In the absence of any definite provision in the technical specifications contained herein,
  reference may be made to the latest CPWD, MOST, IRC, ICAO Specifications and IS
codes, in that order. Wherever these are silent, the construction and completion of
  the works shall conform to sound engineering practice and in case of any dispute arising out
  of the interpretation of the above, the decision of the Engineer-in-Charge shall be final
  and binding on the Contractor.
• In addition, to abbreviations CPWD, IRC, MOSRT& H, BIS, BS, ICAO ASTM, AASHTO
  shall be considered to have the following meaning:

  CPWD : Central Public Works Department
  IRC : Indian Road Congress
  MOSRT&H : Ministry of Shipping & Transport (Road Wing) Govt. of India.
  BIS : Bureau of Indian Standards
  BS : British Standard of the British Standard

Tech. Specification - 5
ICAO: International Civil Aviation Organization
AASHTO: American Association of State Highway and Transportation Officials.

- All the codes of practice, standards and specifications applicable shall be the latest editions with up to date correction slips etc. or as directed by the Engineer-in-Charges.

Testing

It is made clear that cost of testing, cost of material for testing, all field apparatus required for sampling and testing as per CPWD/IS codes and manpower incident to such testing will be provided along with necessary transport arrangement to and fro to the approved testing agency or laboratory by the Contractor during the construction phase of the work and defect liability period. The expenditure in this regard shall be borne by the Contractor and nothing extra shall be payable by owner on this account. Field laboratory with all the required apparatus and staffs shall be established by the Contractor at site of work at his cost for carrying out field tests at stipulated frequencies.

Sampling and Testing

The Contractor or his accredited representative shall be present during sampling/testing and signify his concurrence for sampling / testing carried out by signing the test records. The Contractor shall be liable of all actions consequent to the test and their results as if he himself attended to the tests. The Contractor is duly advised to be present himself for sampling and testing or in the alternative, have fully qualified duly authorized Engineer for this purpose.

General list of codes, standards and specifications adopted in the tender documents

The following IRC standards and IS, ASTM, British Standards, Codes and CPWD Specifications have generally been adopted in the tender documents. This list however does not limit the use of any other relevant code or standards by the Engineer-in-Charge solely at his discretion either referred to in the tender documents or not, to achieve the desired quality of work. All the codes practice, standards and specifications applicable shall be the latest edition with all correction slips, etc. or as directed by the Engineer-in-Charge.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>IS CODE</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IRC SPECIFICATION IRC:10-1961</td>
<td>Recommended Practice for Borrow pits for Road Embankments Constructed by Manual Operation</td>
</tr>
<tr>
<td>2</td>
<td>IRC:19-1977</td>
<td>Standard Specifications and Code Practice for Water Bound Macadam (Second Revision)</td>
</tr>
<tr>
<td>3</td>
<td>IRC:SP II-1977</td>
<td>Hand Book of Quality Control for Construction of Roads and Runways (First Revision).</td>
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<td>5</td>
<td>IS:456-2000</td>
<td>Plain &amp; reinforced concrete code – fourth revision</td>
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<td>6</td>
<td>IS:460-1985</td>
<td>Testing Sieves</td>
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<td>7</td>
<td>(Part-I to III) IS:516-1959</td>
<td>Methods of test for strength of concrete.</td>
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<tr>
<td>8</td>
<td>IS:1124-1974</td>
<td>Method of test for water absorption, apparent specific gravity and porosity apparent specific gravity and porosity of Natural Building Stone.</td>
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<td>9</td>
<td>IS:1199-1959</td>
<td>Methods of sampling and analysis of concrete</td>
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<td>IS:2386- Part-I</td>
<td>Methods of test for aggregate for concrete – Particle and shape</td>
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<td>13</td>
<td>IS:2386-1963 Part-IV</td>
<td>Methods of test for aggregate for concrete - Mechanical Properties</td>
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<td>IS:2386-1963 Part-V</td>
<td>Methods of test for aggregate for concrete - Soundness</td>
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<td>IS:2386-1963 Part-VII</td>
<td>Methods of test for aggregate for concrete - Alkali Aggregate reactivity</td>
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<td>IS:2386-1963 Part-VIII</td>
<td>Methods of test for aggregate for concrete - Petrographic examination</td>
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<td>18</td>
<td>IS-2720 Part-II)-1973</td>
<td>Methods of test for soils: Part 2 Determination of water content</td>
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<td>19</td>
<td>IS-2720 Part-III)- Section-II 1980</td>
<td>Determination of Specific Gravity - Section 2 : Fine, Medium and Coarse Grained Soils</td>
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<td>IS-2720 Part IV)- 1985</td>
<td>Methods of Test for Soils - Part 4 : Grain Size Analysis</td>
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<td>22</td>
<td>IS-2720 Part-VII)- 1980</td>
<td>Determination of Water Content-Dry Density Relation Using Light Compaction</td>
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<td>23</td>
<td>IS-2720 Part-VIII)- 1983</td>
<td>Methods of Test for Soils - Part 8 : Determination of Water Content-Dry Density Relation Using Heavy Compaction</td>
</tr>
<tr>
<td>24</td>
<td>IS-2720 PartXVI- 1987</td>
<td>Methods of Test for Soil - Part 16 : Laboratory Determination of CBR</td>
</tr>
<tr>
<td>26</td>
<td>IS-2720 Part-XXVIII-1974</td>
<td>Determination of dry density of soils in place by the sand replacement methods.</td>
</tr>
<tr>
<td>29</td>
<td>IS:6241-1971</td>
<td>Method of test for determination of stripping value of road aggregate.</td>
</tr>
<tr>
<td>30</td>
<td>IS:8112-1989</td>
<td>43 grade ordinary Portland cement</td>
</tr>
<tr>
<td>31</td>
<td>IS:12118-1987 (Part I &amp; II)</td>
<td>Two parts polysulphide based sealants.</td>
</tr>
<tr>
<td>33</td>
<td>ASTM:D-2172-1975</td>
<td>Extraction quantitative, of Bitumen from bituminous paving mixtures</td>
</tr>
<tr>
<td>34</td>
<td>ASTM : E-11-39</td>
<td>Sieves for testing purpose “Wire Cloth sieve round hole and square” hole plate screen or sieves.</td>
</tr>
<tr>
<td>35</td>
<td>BS:410-1969</td>
<td>Test Sieves.</td>
</tr>
<tr>
<td>36</td>
<td>ASTM- A653</td>
<td>Galvanized Steel</td>
</tr>
<tr>
<td>37</td>
<td>BS – 2989</td>
<td>Galvanized Steel</td>
</tr>
<tr>
<td>38</td>
<td>BS – 476</td>
<td>Fire propagation &amp; surface spread of flames</td>
</tr>
</tbody>
</table>
**Item no. 3.06:**

Expansion Joint Filler Board - Providing and fixing Armour Board (SIL –FIL ) or approved equivalent of Dawn colour between expansion joints, thickness built up using 10mm specifically extruded high performance sheet minimum density 30 kg per cum and compression strength 0.21 Kg./Sqm when tested as per ASTM D-3575 including using double sided adhesive SIL tape (manufactured by Supreme Industries Ltd. or equivalent) of 25x25x2 mm at four places per Sqm to the casted surface to form the expansion joint Armour Board (SIL – FIL) or approved equivalent will become one side of the shuttering while the expansion joint is being created, including cost and conveyance of all materials, labour charges, sundries etc. complete as per drawings and as directed by Engineer-in-Charge..

(a) **Width of the joint:** - 100 mm.

**3.06.1 MATERIAL**

**Expansion Joint Filler Board**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Parameters</th>
<th>Units</th>
<th>Test Result</th>
<th>Tested as per</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Water Absorption</td>
<td>Kg/Sq. Mtr</td>
<td>0.45 Max</td>
<td>ASTM – D3575</td>
</tr>
<tr>
<td>2.</td>
<td>Density</td>
<td>Kg/Cu.Mtr</td>
<td>28 Min</td>
<td>Do</td>
</tr>
<tr>
<td>3.</td>
<td>Compression Strength (25% Deflection)</td>
<td>Kg/Cm Sq</td>
<td>0.21 Min.</td>
<td>Do</td>
</tr>
<tr>
<td>4.</td>
<td>Compression Set</td>
<td>%</td>
<td>25% Max</td>
<td>Do</td>
</tr>
<tr>
<td>5.</td>
<td>Tensile Strength</td>
<td>Kg/Sq.Cm</td>
<td>1.8 Min.</td>
<td>Do</td>
</tr>
<tr>
<td>6.</td>
<td>Elongation</td>
<td>%</td>
<td>60 Min</td>
<td>Do</td>
</tr>
</tbody>
</table>

**Expansion joint adhesive SIL tape**

VOC Content should be < 70 g/l or No/zero-VOC (Such as acrylics or phenolic resins, phenol formaldehydes)

**3.06.2 LAYING PROCEDURE**

While creating expansion joint the expansion joint filler board will become one side of shuttering. To hold two free sides of shuttering a MS bolt of 12mm dia with both sides threaded will be used at every 1 Mtr intervals with matching nuts with concrete sleeve 50mm x 50 mm. This bolt will take out & hole of sleeve is to be grouted afterwards with cement mortar.

When forming expansion joint with expansion joint filler board in in-situ concrete, joint-sealing slots is to be formed in the following manner.
The expansion joint filler board is to become one side of shuttering. Cut off a strip of expansion joint filler board equal to D. Further, cut the strip along the joint length into two.

The depth of top strip should be = (1.25 W or W + 5mm whichever is less) + (W/2 or 15mm whichever is less) and the bottom strip = (D-top strip), where D = slot depth in MM & W = slot width in MM

Pin the top strip back on to the bottom strip using nails at two-inch intervals. Ensure that the slot is clean and dry. Install a strip of filler material on top of expansion joint filler board flush with finished surface using either a separation Tape/synthetic rubber based adhesive.

Just prior to sealing pull off the top strip to create an uncontaminated sealing slot ready for preparation & sealing.

**Item no.3.07:**

Providing and fixing in position Floor Expansion Joint covers ((Model no. React-300-A01-100 series or equivalent as manufactured by VEXCOLT, U.K.), Sainfield, Deevin, Hercules or equivalent for internal horizontal joints in the floor slab including cost and conveyance of all materials, labour charges, Neoprene Elastomeric Seal, sundries etc. complete as per drawings and as directed by Engineer-in-Charge.

(a) **Width of the joint: - 100mm (Floor to Floor - Horizontal)**

**3.07.1 MATERIAL**

The material shall be such that it provides floor to floor expansion control system in Plant / Heavy load application areas that accommodates 100% movement without stress to its components. System shall consist of metal profiles with a universal aluminum base member designed to accommodate various project conditions and finish floor treatments, anchored to the RCC slab/floor using masonry anchor (24”). The centre plate shall be designed of width and thickness required to satisfy projects movement. The top plate shall be designed of width and thickness required for loading requirements and secured to base members by utilizing manufacturer’s pre-engineered arrangement that freely moves in horizontal directions. The top plate will have serrations to avoid slippery surface. The Locking arrangement shall exhibit slide inside the corresponding aluminum extrusion cavity to allow freedom of movement and flexure. Provision of Moisture Barrier Membrane in the Joint System to have watertight joint is mandatory requirement. Material to conform to the following properties;

- Cover Plate 6063-T6 ASTM B221
- Center Plate 6063-T6 ASTM B221
- Base Frame 6063-T6 ASTM B22
3.07.2 APPLICATION PROCEDURE

Expansion joint shall be provided as shown in the drawing and as per direction of Engineer-in-Charge. All joints should be cleaned and free from loose aggregates, the edges should be in proper line. The joint should be of the appropriate width as per the drawings.

Provide continuous frame on each side of the joint, designed to support gasket and center plate where required. After installing the frames at both sides, place the center plate in between the two frames and finally flush the gasket on the top of the frames.

Fixing of the joint after proper assembly of the components should be through the proper stainless steel counter skunked screws, which should be drilled to the base concrete slab beams with a bonding agent.

Item no. 6.17:

Providing and fixing in position single / double, leaf fire check doors and chowkhat frames at all levels of approved make, design, finish, tested and certified at CBRI, Roorkee etc. complete in all respect as per specifications and direction of Engineer-In-Charge and consisting of:-.

a) 46mm thick M.S fire rated door of 120 minutes fire rating fabricated with 2 nos. 1.2mm thick galvanised sheet with infill of fire rated proprietary insulation filler both faces of sheet with lock seam joints at stile edges and internal reinforcement at top, bottom and stile edges for fire rating. The door frames are manufactured from 1.6mm thick galvanised steel sheet pressed form to double rebate profile of size 154mm x 77mm (nominal). The door frames and door shutters are primed with etch primer and finished with PU/Powder coated. The shutter would be mounted with SS Ball Bearing Hinges of size 100mm x 75mm x 3.0mm of Becker Fire Solutions (4Nos per leaf), appropriate openings for view panel glass, if required. Prototype Test certificate for a test carried out earlier at CBRI Roorkee for fire rating of doors, shall be attached along with manufacturers test certificate. Provisions for fixing all fixtures shall be built in on the doors prior to the supply.

b) 6mm thick nominal pilkington pyroshield / Central Fire Rated Clear Glass of 120 minutes rating one on each leaf of size 200 x 300mm.

The item includes cost of providing and fixing SS ball bearing hinges of DORMA or equivalent as approved (4330)m mortise sash lock with SS handles side key operation of DORMA make XLC-7210 or equivalent as approved / Mortice Dead Lock of DORMA make XLC-706 or equivalent as approved, SS D type Pull handle TGDI-D 250 X 19 mm of DORMA make or equivalent as approved, panic latch and bolt of DORMA make PHCR 1000 Series (CROSSBAR) or equivalent as approved as and where required as per site requirement. Overhead Door Closer of DORMA make TS-68 or equivalent as approved (with standard arm. The supply should be made along with valid test report from international test house Warrington(U.K.).

(a) Single/Double Leaf Door with vision with a guarantee of 120 minutes fire rating
(Please note :- The contractor should give the guarantee bond of fire rating).

6.17.1 Material

The fire door to be supplied and installed as per the above mentioned specifications and to be approved by the engineer in charge.
Fire rated hardware:

a) Door closer confirming to CE & EN 1154 and B.S. – 476, Part-22, two hours fire rated.


c) Mortice Lock with lever handle confirming to CE & EN 122090/DIN 18251 and B.S.-476, Part-22, two hours fire rated.

d) Stainless steel ball bearing hinges 4 nos. on each side of Wooden shutters size 100 mm x 100 mm x 3 mm with screws etc. complete.

f) Vision panel: 5 mm thick fire lit clear glass, Fire Rated Clear Wired Glass of 120 minutes rating one on each leaf of size 300 x 150 mm.

6.17.2 Testing

The fire doors shall be tested by CBRI/ International Test House in accordance with BS 476 part 22. Galvanized steel to be used conforming to IS 277 of 92. The supply should be made along with valid test report from international test house Warrington (U.K.).

Item No. 6.18

Providing and fixing Floor Mounted Toilet cubicals with door, pilaster and divider of 18mm thick board both side decorative compact laminate of required colour, shade and sizes as manufactured by Besco by Merino (Titan std) or Greenlam Sturdo Classique Grandeur or Solace (SS series) by SPCMS or Shapoorji Pallonji & Co Ltd or approved equivalent including stainless steel accessories (SS-304 grade) like square top rail, legs, knob, thumb turn and indicator, twin coat hook, door stopper, adjustable legs, gravity hinges, and locking arrangement, SS channel etc as desired. all complete as per drg and direction of Engineer in charge. (Cubical size =(1050x1625)mm, Cubical Height =2100mm, External Laminate finish = Metallic)

Cubical size =(1050x1650)mm

Cubical Height =2100mm

Door height = 2100mm

External Laminate finish = Metallic or as approved

6.18.1 STORAGE

Storage of materials to be used on the job shall be only in a single place approved by Engineer in charge. Such storage place, shall not be located within any of the buildings included in the contract.

6.18.2 MATERIALS

Compact Laminates board used in the work shall be of as per manufacture or Greenlam Sturdo or Merino or Funder max of approved by the Engineer in charge.
6.18.3 FIXING

During Installation where fixed to solid masonry or concrete shall be secured with expansion bolts or other positive method of mechanical fastening. All fixing and Installation method shall be used as per manufacturer specifications and direction of Engineer in charge.

6.18.5 Joinery

Joinery shall be carried out strictly in accordance with the drawings.

6.18.6 Fastenings

Screws, nails etc., shall be of standard iron or wire unless otherwise shown on drawings screws and nails for outdoor furniture shall be of brass or other non-corrosive metal.

Exposed fastenings shall unless otherwise detailed be sunk and the hole plugged with a wood plug of the same wood and grain of the finished surfaces. Nails on finished surfaces shall be neatly punched and the hole filled with wood filler to match.

6.18.7 WORKMANKSHIP

The workmanship shall be of the very best, all materials a properly qualified foreman shall be constantly on the job while the work is proceeding. All surfaces shall be cleaned free of all loose dirt and dust.

6.18.8 CONCEALED SURFACES

All interior and exterior Stainless steel trim, doors. work shall be thoroughly similarly finish and all surfaces and edges which will be concealed when installed. All surfaces shall be neat and clean.

6.18.9 PROTECT AND CLEAN

Contractor shall protect not only his own work at all times. But shall also protect all adjacent work and materials by suitable covering during progress of his work. Upon completion of his work, he shall remove all unserviceable materials spots from floors, walls, and other surfaces. Any defaced surfaces shall be cleaned and the original finish restored. He shall remove from the premises all rubbish and accumulated material and shall leave the work in clean, orderly and acceptable conditions.

6.18.10 ACCESSORIES

All the accessories used in cubicles are of stainless steel grade 304.

6.18.10 FINISH

Factory made finish as per manufacturer and approved by Engineer in charge.
Item No. 8.10

Providing and laying Digital Placement of Color / 100% Solution Dyed Nylon 6.6 carpet tiles Tufted level Loop Pile tiles of Milliken / Mohawk / Interface or approved equivalent of approved shade & size 500 x 500 mm / 600 x 600 mm with protective stain treatment(s), soil protection to repel and resist Stain and Anti Microbial treatment, Appearance Retention Rating (CRI 101) for severe use with PVC free backing having min. face eight of 10 gsm conforming to ASTM – 648 Flooring Radiant Panel Class I grade including fixing with Volatile Organic Compound (VOC) Free Adhesive etc. complete as per drawing and directions of Engineer-In-Charge.

8.10.1 MATERIAL

The Solution Dyed Nylon carpet tile shall conform to the following specifications:

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Construction</td>
<td>Tufted Textured Loop Pile</td>
</tr>
<tr>
<td>2</td>
<td>Yarn/ Fiber</td>
<td>Nylon 6,6</td>
</tr>
<tr>
<td>3</td>
<td>Gauge / Carpet thickness</td>
<td>Min. 1/10”</td>
</tr>
<tr>
<td>4</td>
<td>Yarn weight</td>
<td>Min. 24 oz per sq.yd</td>
</tr>
<tr>
<td>5</td>
<td>Tufts</td>
<td>2230.3/100 sq. cm</td>
</tr>
<tr>
<td>6</td>
<td>Rows/ Stitches</td>
<td>Min. 9.9/ Inch</td>
</tr>
<tr>
<td>7</td>
<td>Primary backing</td>
<td>Non Woven</td>
</tr>
<tr>
<td>8</td>
<td>Secondary backing</td>
<td>PVC-Free Hard Back/Comfort Plus</td>
</tr>
<tr>
<td>9</td>
<td>Minimum Density</td>
<td>6000 oz per cu yd</td>
</tr>
<tr>
<td>10</td>
<td>Tile Size</td>
<td>500 x 500 mm / 600 x 600 mm</td>
</tr>
<tr>
<td>11</td>
<td>Indoor Air Quality</td>
<td>CRI Green Label Plus Certification</td>
</tr>
</tbody>
</table>

Before starting the work the contractor shall get the sample of carpet tiles approved by Engineer- in-charge.

8.10.02 LAYING

Flooring shall be neatly levelled with smoothly cemented surface. All the junction boxes to be covered & levelled to the cemented surface. All the expansion joints to be covered or levelled properly. Wall corners & below the skirting (if applied) shall be dust free. Before laying carpet one coat of paint shall be applied on floor & dust free. Skirting work to be completed before laying carpet.

ADHESIVE

Green Adhesive is a releasable, pressure sensitive adhesive specially engineered to install carpet tiles. This premium adhesive is formulated to facilitate release & rebonding of carpet tiles while permanently retaining its tack, allowing individual tiles to Vadoara Airport be lifted out easily and replaced without substantial loss of adhesive properties for the life of the installation.

Tech. Specification - 14
8.10.3 QUALITY ASSURANCE Performance Specifications

Radiant Panel: (ASTM E-648) Class 1
Smoke Density: (ASTM E – 662)
Light fastness: (AATCC 16 – E)
Static: (AATCC – 134) < 3.0 KV

Item No. 10.03

Supply, Providing, Fabricating, Assembling and erecting at site Tubular Structure (Roof Trusses, Runner, Purlin, sky light roofing structure, frame work or similar work) consisting of MS Pipe, and metal casing conforming to IS 1161 Grade 310 [Tubular Structure made from Steel hollow sections, ISI marked from SAIL / RINL / TATA/ APOLLO or approved equivalent make, conforming to IS 1161/4923, Grade Yst 310, different thickness (Steel hollow sections confirming to IS 1161/4923 (Grade Yst 310) and Rolled section & plates confirming to IS 2062 (Grade Yst 250)) in the profile shaped as per drawings with special plate connector, pinion joints, Plates, hollow sections etc sing SAW/MMAW/MIG welding process with special plate connectors, pinion joints, plates, hollow sections etc. using SAW/MMAW/MIG welding process with cleaning the surface and applying a coat of epoxy primer, and including transportation, cutting, threading, machining, leads and lifts upto all heights, tools and plants and necessary scaffolding etc. required for all operations involved to make structure of terminal building. The tubular structure system with plate connectors, pinion joints, etc. is to be provided.

The complete structure to be painted with one or more coat epoxy primer (low VOC i.e less than 250 gm/ltr) and one or more coats of acrylic finish Polyurethane paint (low VOC i.e less than 250 gm/ltr) on steel work at all locations prepared by sand blasting and applied with airless spray in required DFT (dry film thickness) as per technical specifications and as per direction of Engineer-in-Charge. The structural drawings shall be provided by Consultant; however the contractor has to prepare shop drawings which have to be approved by Engineer-in-charge/Consultant before start of work. The cost includes supplying, fabricating, erecting of tubular structure including welding, scaffolding, cost of primer, polyurethane paint application etc complete.

(Please note that rate is inclusive of lifting if required by cranes/ scaffolding or by any other means complete in all respects.)

10.03.1 General

The above item includes supplying, providing, fabricating, assembling, and erecting at site Tubular structure in the bended profile shaped as per the drawing with special plate connectors, pinion joints, using SAW / MMAW / MIG welding process with cleaning the surface and applying a coat of epoxy primer.

10.03.2 Materials

MS Plates confirming to IS 2062 YST 250 Gr. and Tubular Hollow Section Conforming to IS 1161/4923, Yst-310.

Bolts to be high tensile bolts of minimum 10.9 grades having black phosphate coating. The Bolts should be as per IS 3757/ IS 4000. Bolts shall be provided with a washer of
sufficient thickness to avoid any threaded portion falling within the thickness of the parts bolted together if required.

The bended purlins in the profile as per drawing should be connected to the profiles MS Rakers with suitable arrangement; Metal casing shall be provided at the end of Rakers as per the drawings. The bending of the members wherever specified should be in exact profile as per requirement.

Connector should be of high strength, manufactured out of similar grade of steel material of required dimensions and holes for the bolts in the required position and direction. The item includes cleaning the surface and painting one coat of epoxy primer and two coats of polyurethane paint etc complete.

The structure should be properly bended, connected welded and aligned to get the required profile.

10.03.3 Execution

Tubular structures (in truss pattern as per design and drawings) shall be got executed by specialized agencies having requisite experience in execution of similar works of similar magnitude as approved by Engineer-in-Charge.

The structure should be properly bended, connected, welded and aligned to the required profile, i.e. work shall be executed as per designs given and workshop drawing prepared by the agency and got approved by the Engineer-in-Charge.

Tubular structure system with plate connectors, pinion joints, etc. complete in all respects to make structure of main Terminal Building is to be provided.

All components of tubular frame to be cleared off the dusts/ scales etc. completely before applying primer.

10.03.4 Shop drawings

The works includes preparation of shop drawings giving complete information, necessary for the fabrication of the component parts of the structure including the location, type, size, length and detail of all welds, and nuts, bolts, rivets etc. as per provided Design drawings. The shop drawings shall be sufficient to ensure convenient assembly and erection at site. These drawings shall also include full details of all joints, connections, splices etc.

The specification deals with the fabrication and erection of steel structures for main roof of the main building of the Airport. Size of pipes and dimension as shown in the drawings indicate complete plan layout of the proposed structure together with sections and relative locations of various members. The plate, pipes, tubes and members etc. are to be provided as per approved structural design and shop drawings.

10.03.5 Fabrication Procedure

10.03.5.1 Assembly

All connections shall be either bolted or welded as shown on the drawings. The contractor shall not redesign or alter any connection without prior approval of the Engineer-in-Charge. The components parts shall be assembled in such a manner that they are neither twisted nor otherwise damaged and shall be prepared such that the
specified cambers, if any, are provided. Drifting done during assembly shall not distort the metal or enlarge the holes.

10.03.5.2 Bolting

a) All steel work, which is bolted together, shall be in close contact over the whole surface. Where two bolted surfaces are to be in permanent contact after assembly, each shall be thoroughly scraped free of loose scales, dirt and burs and a heavy coat of red oxide, zinc phosphate or other approved paint applied after cleaning and drying.

All bolts shall be providing with washers under the nuts and the washers shall be tapered on the inside of the flanges or RS joists and channels. Bolts and studs shall project not less than one full thread through the nut after tightening. Unless otherwise specified, the ends of the bolts shall be burred after erections of prevent the removal of nuts.

b) High tensile steel bolts of grade 10.9 (as per IIT Delhi report) shall be used in bearing of friction as shown on the drawings. High strength bolted joints shall be made without the use of erection bolts. Bolts shall be of a length that will extend not less than 10mm beyond the nuts. Bolts shall be entered into the holes without damaging the thread-members. They shall be brought tightly together with sufficient high-strength fitting up bolts, which shall be re-tightened as all the bolts are finally tightened. Bolt heads shall be protected from damage during placing. Bolts that have been completely tightened shall be marked for identification. Bolted parts shall fit solidly together and shall not be separated by interposed compressible materials. The contract surface in high strength bolted connections shall be free of oil, paint, lacquer, loose scale or other coatings. The facing surfaces shall be machined flat. Final tightening of high strength bolts shall be by turn-of-nut method.

c) Anchor bolts shall be set by use of templates secured firmly in place to permit true positioning of the bearing plates and assembles. When in drawings anchor bolts are shown to be installed in sleeves, the sleeves shall be completely filled with grout.

10.03.5.3 Welding

a) Welding shall be done in accordance with IS-816-code of practice for use of metal arc welding for general construction in mild steel.

b) IS: 820 - Code of Practice for the use of welding in tubular construction.

Shearing, chipping or gas cutting may prepare profile of fusion faces. In all cases the faces should be dressed by chipping, filling or grinding and made regular.

The surface to be welded and adjoining metal for distance of at least 20mm must be clean free of rust, scale, paint etc.

Each bead of metal shall have the slag removed by light hammering and wire brushing before the next bead is deposited. The weld must show a good clean contour and on a cut specimen good fusion with parent metal. Before applying paint the weld shall be carefully chipped and wire brushed.

Welding procedure shall be based on the specific analysis of any given heat of steel and shall be subject to the review of the Engineer-in-Charge.
These procedures shall call for one or all the following:

**Proper bead shape:**

Minimized penetration to prevent dilution of the weld metal with the alloy elements. Preheating, controlled inter-pass temperature and controlled heat input.

Welding shall be performed only by qualified and tested welders specifically trained and experienced for the type of job required to execute the welding work to the complete satisfaction of the Engineer-in-Charge. Welder should have minimum five years of experience in the job of similar nature.

Use of standard weld symbols as adopted by IS:813 is mandatory. Pre-qualified jointed which are detailed, prepared and welded in accordance with the requirement of IS:816 shall invariably be used.

Structural welding shall not commence until joints elements are bolted or tacked in intimate contract and adjusted to dimensions shown with allowance for any weld shrinkage that is expected. Welding sequence shall be planned and controlled to minimize undue stress increase or undue distortions on restrained members. Heavy sections and those having a high degree of restraint shall be welded with low hydrogen type electrodes.

Concave bead shape shall be avoided. Radio of weld width to weld depth shall preferably vary from a minimum of 1 to 1 to a maximum 1.4 to 1.

- \[
\frac{\text{Width of weld}}{\text{Depth of fusion}} = 1 \text{ to } 1.4
\]

Field Welding shall not be permitted unless shown on the drawings. Subsequent to fabrication, the overlapping or contracting surfaces or other closed sections (such as tubular, box section) which are inaccessible to painting shall be seal welded when the end of the tube is not automatically sealed by virtue of its connection by welding to another member the end shall be properly and completely sealed. Before sealing, the inside of the tube shall be made dry and free from loose scale.

Order of assembly of the tubular section shall consist of welding the tensile member to the main member first. Compression member shall be cut back to overlap the tensile member and then welded to both the tensile members.

**10.03.5.4 Inspection of Welding**

All welded connection shall be inspected as per IS:822.

**10.03.6 Erection**

As far as possible, the contractor shall deliver the fabricated steel work to the site in the same sequence as that which he wishes to follow for the erection. Dispatch should be scheduled to avoid cluttering up of the site. The bolts required for erection shall be bagged according to size prior to dispatch.

All structural work shall be erected in accordance with IS: 800, IS: 806 and IS: 1915 and as per the approved erection drawings. The contractor shall be responsible for setting out the works. The suitability and capacity of all plant and equipment used for erection shall be to the satisfaction of the Engineer-in-Charge. These shall be regularly serviced.
and maintained. Occupation safety practices shall be strictly adhered to and shall be to
the satisfaction of the Engineer-in-Charge.

Individual places shall be plumbed, levelled and aligned. Drifting shall be used only to
bring together the several arts. They shall not be used in such manner as to distort or
damage the metal. Temporary bracing, but-line and staging shall be provided to ensure
proper alignment and to adequately protect all persons, property and to withstand all
loading to which the structure may be subjected during erection.

Attachment of such temporary steel work to the permanent steel work shall only be done
with the approval of the Engineer-in-Charge. Temporary steel work shall remain in
position until the structure is stable and self supporting and permanently bolted or
welded to the satisfaction of the Engineer-in-Charge after removal of temporary steel
work, the permanent structure shall be made good to the complete satisfaction of the
Engineer-in-Charge.

No permanent bolting or welding shall be done until proper alignment has been
obtained. Erection of the parts with any moderate amount of reaming, chipping or
cutting shall be immediately reported to the Engineer-in-Charge. The steel work shall be
rejected unless corrective action is approved by the Engineer-in-Charge.

Placement of joists shall not start until the supporting work is secured. Temporary
bridging, connections and anchors shall be proved to assure lateral stability during
erection. Bridging to steel joists shall be installed immediately after joint erection, before
any construction loads are applied. Horizontal or vertical bridging shall be provided in
accordance with the type of span of the joists. Ends of the bridging lines shall be
anchored at top and bottom chords where terminating to walls or beams.

10.03.7.1 Surface Preparation & Comments

Abrasive blast cleans to Sa2.5 (ISO 8501-1:1988) or SSPC-SP6. If oxidation has
occurred between blasting and application, the surface should be re-blasted to the
specified visual standard. Surface defects revealed by the blast cleaning process,
should be ground, filled, or treated in the appropriate manner.

All surfaces to be coated should be clean, dry and free from contamination. Prior to
paint application all surfaces should be assessed and treated in accordance with ISO
8504:1992. Oil or grease should be removed in accordance with SSPC-SP1 solvent
cleaning.

10.03.7.2 Paint System:-

<table>
<thead>
<tr>
<th>General Surfaces</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primer coat</strong></td>
</tr>
<tr>
<td>A two component epoxy zinc phosphate micaceous iron oxide primer offering rapid recoat technology with hard dry in 3 hours @ 25 C, minimum volume solids of 80% and having VOC less than 250 g/l like Intercure 200HS or approved equivalent.</td>
</tr>
<tr>
<td>The DFT 150 - 200µ (6-8 mils) per coat.</td>
</tr>
<tr>
<td><strong>Finish Coat</strong></td>
</tr>
<tr>
<td>Two component High Gloss Acrylic Polyurethane Finish Paint with approximate Volume solids of 70-75%, having VOC &lt; 250 g/l, with gloss retention of minimum 80% after 2000 hours exposure to UV A Fluorescent lamp as per ASTM D523 like Interthane 990UHS or approved equivalent.</td>
</tr>
<tr>
<td>The DFT in one or more coat shall be 75-100 microns.</td>
</tr>
</tbody>
</table>
DFT Measurement should be in accordance with SSPC SPA 2. The entire paint system shall be of same manufacturers.

10.03.7.3 Painting of Structural Steel

All Paints delivered to the shop shall be ready mixed in original sealed containers, as packed by the paint manufacturers.

Painting shall not be carried out when the steelwork temperature is below 4 degrees C, above 50 degrees C, Jess than 3 degrees C above the dew point, or when the relative humidity is above 80%.

Paint shall be applied in accordance with manufacturer’s recommendation, as supplemented by these specifications. The work shall be generally follow IS: 1477 – (part-II). Prior approval of Engineer shall be taken in respect of all primer or paints, before their use in works.

Paint shall not be applied when the ambient temperature is 10 deg C and below.

For Brush Application: Proper brush shall be selected for a specific work piece. Round or oval brush which confirms to IS: 487 are better suited for irregular surfaces, whereas flat brushes which confirm to IS: 384 are convenient for large flat areas.

For Spray Application: The spraying equipment shall be compatible with the paint material and provided with necessary gauges and controls. The equipment shall be cleaned of dirt, dried paint, foreign matter and solvent before use.

10.03.7.4 Product Characteristics:

**Epoxy Primer**

<p>| | |</p>
<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Volume Solids</strong></td>
<td>80 %( Max)</td>
</tr>
<tr>
<td><strong>VOC</strong></td>
<td>Less than 250g/liter</td>
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<tr>
<td><strong>Product Weight</strong></td>
<td>1.67-2.0 Kg/lt</td>
</tr>
<tr>
<td><strong>Colour</strong></td>
<td>Sand, Grey, Red</td>
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<tr>
<td><strong>Typical Thickness</strong></td>
<td>150 - 200µ (6-8 mils) per coat</td>
</tr>
<tr>
<td><strong>Theoretical Coverage</strong></td>
<td>5.30 m²/litre @ 150µ dft</td>
</tr>
</tbody>
</table>
Polyurethane Paint

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Volume Solids</strong></td>
<td>70%-75%</td>
</tr>
<tr>
<td><strong>VOC</strong></td>
<td>Less than 250g/liter</td>
</tr>
<tr>
<td><strong>Product Weight</strong></td>
<td>1.4 Kg/ltr (11.7 lb/gal)</td>
</tr>
<tr>
<td><strong>Colour</strong></td>
<td>As per RAL Standard / or approved by E-I-C</td>
</tr>
<tr>
<td><strong>Typical Thickness</strong></td>
<td>75 - 100µ (3-4 mils) per coat</td>
</tr>
<tr>
<td><strong>Theoretical Coverage</strong></td>
<td>9.5-12.0 m²/litre @ 75µ dft</td>
</tr>
</tbody>
</table>

**Item No. 11.05**

Providing and fixing Roof Skylight as shown in enclosed drawings with multicell Polycarbonate sheet (Danpalon / Lexan/Gallina or Equivalent) of minimum thickness 16 mm with 5 cells-6 wall having wall flange and supporting wall thickness as per manufacturer specifications. Extruded translucent panels with vertical standing seam at both sides of panels of the Panel with Snap-on connector to interlock the panels with a double tooth grip-lock mechanism to ensure maximum uplift capability including End-cap/Aluminium U-Profile (mill finish) for ends. Panels shall be co-extruded UV protected with anti-glare color on one side to prevent glare and shall face sun/top. The panels shall be fixed pre installed structural M.S.frame work (M.S. structure shall be paid separately in relevant item) and be secured with snap-on connectors at all levels including all accessories like screws, washers, flashing, trims etc complete to make a water tight skylight system including transportation, lift, scaffolding, etc. conforming to specifications and directions of Engineer-in-Charge.

The items cost includes supplying, installation and fixing of 20 to 22mm multicell polycarbonate sheet over structural frame work, Labours, Scaffolding all required machineries for fixing tools etc. including cost of weather sealants, aluminium channel, screws with pvc fillets, masking tape, protective tape, backer rods, bolts, gasket, any scaffolding, sales tax / VAT, excise duty etc. to complete in all respect. However the cost of M.S. structural steel framework shall be measured and paid separately.

**11.05.1 Materials**

The polycarbonate system shall consist of:

(a) Panel shall be 20 to 22mm thick (min.)
(b) Panel width shall be of 900 to 1220 mm to ensure best performance for wind uplift, vibration, oil canning and visual appearance.
(c) Panels shall be manufactured with Vertical Standing seam at both sides of the panel. Welding or gluing of upstands or standing seam is not acceptable.
(d) Snap-on connector to interlock the panels shall have a grip-lock double tooth locking mechanism to ensure maximum uplift capability.
(e) End-cap/Aluminium U-profile (mill finish) for ends.
(f) Panels shall be co-extruded UV protected and softlight type to prevent glare. UV protected side shall always face the sun/top.
(g) The full system shall be fitted on MS purlins perpendicular to direction of sheeting with appropriate purlin spacing.
11.05.2 Specifications For Colour Coating

(a) Colour: As approved by Engineer-in-Charge.
(b) Light Transmission – 51%
(c) Solar Radiation Transmission – 29% to 32%.
(d) U-Value – 1.53 to 1.69 w/m²C⁰.

MATERIAL PROPERTIES

<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>TEST CODE / ACCEPTANCE LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weathering</td>
<td>ASTM D4364-84</td>
</tr>
<tr>
<td>Light Transmission</td>
<td>ASTM D1003</td>
</tr>
<tr>
<td>Water Penetration</td>
<td>ASTM E-331</td>
</tr>
<tr>
<td>Air Infiltration</td>
<td>ASTM E-283</td>
</tr>
<tr>
<td>Impact</td>
<td>ASTM E-222-81</td>
</tr>
</tbody>
</table>

ITEM NO. - 10.02

Providing and fixing curtain glazing as shown in enclosed drawing with insulated 28mm thick toughened double glass consisting of outer 6mm thick high performance toughened glass on clear substrate + 16mm air gap + inner 6mm thick toughened clear glass, using heavy duty aluminium extruded built up profiles. The outer 6mm thick glass shall be solar control, as well as thermal control, UV protected with high light transmission properties. The outer glass shall be heat reflective having solar control (SF- 0.20 to 0.25), U values (less than 1.4 w/sqm.k), high light transmission (minimum 40%) with internal reflection (12% to 17%) and external reflection (13% to 20%).

Specially designed aluminium mullions and transoms of extruded aluminium sections shall be of 6063-T6 alloy with chemical composition and mechanical properties as per IS: 733:1983 and I.S. 1285:2002.

i) All the aluminium sections shall be pure polyester powder coated to 60 microns as per IS:137871:1993 / I.S. :1868, of approved colour as per direction of the Engineer – in charge. All aluminium profiles shall be wrapped with protective tapes during delivery at site to provide safety against external scratches while loading and unloading. Protective Tapes to be removed as per the instructions of Engineer -In-charge.

ii) Vertical Mullion M1-160mm x 65mm with minimum 3.5mm thickness at the back side, 5.0mm thickness in front and with 2.3mm thick side walls to be fixed to RCC beams / columns & steel beams / columns with hot dipped Galvanized M.S. brackets and stainless steel nuts bolts with PVC / Teflon separator membranes between metal to metal joints at junctions..

iii) Horizontal Transom T1–140mm x 65mm with minimum 3.7mm thickness at the back side, 4.2mm thickness in front with minimum 2.3mm thickness in side walls to be fixed to vertical mullions with stainless steel screws (Grade- S.S. 304) and 4.0mm thick aluminium brackets in such a way that aluminium brackets shall not be seen in vision panels, forming grid systems of required size as per elevation drawings for vision and spandrel glazed panels.
iv) The aluminium glazing members of structural glazing are designed for a wind pressure of 2.0 KN/Sq.m. The design of the system is based on I.S.:875 part III for required wind pressure and use of aluminium section alloy is as per I.S.:8147. System is designed considering thermal movements, air infiltration, water penetration, seismic movement and structural movement with toughened glass.

v) Glazing system shall be having fire stop cum smoke seal system wherever applicable. The structural glazing rates shall includes providing and fixing of fire stop cum smoke seal in spandrel area with 0.7 mm thick G.I. sheet / 2mm thick aluminium sheet duly pure polyester powder coated to 60 micron thickness in approved shade, fabricated in a tray form fixed at a minimum distance of 50 mm from inner face of glass with 50 mm thick Resin Bonded fiber glass / mineral wool slab of density 48 kg/cum with black non woven fiber glass tissue (BGT) facing on one side, fixed between the tray and slab to form a smoke stop. The whole assembly shall be fixed to aluminium framework by stainless steel screws as per detail drawings enclosed.

vi) All components should be sealed for water proofing with weather silicon of Wacker / DOW corning / GE silicones with silicon joint movement minimum + 50% according to ASTM C-920. (Silicone grade shall be used as per the manufacturers recommendations)

vii) The design and the details of aluminium structural glazing shall be provided by consultant. The detailed shop drawings of aluminium glazing works shall be submitted by the specialized agency before execution and got approved by structural consultant / façade consultant through Engineer in charge.

viii) The structural curtain glazing frame shall be aligned for the entire height and for the entire width by laser beam equipment to ensure 100 percent ‘X’ axis and ‘Y’ axis alignment. The entire joints of glazing system must be properly sealed with weather silicon of approved make / grade, to make the joint air tight and water tight. The curtain glazing glass shall be installed / fixed in aluminium framework to the satisfaction of Engineer in charge.

ix) The Expansion joints between two vertical mullions should be joined by inserting 250 mm long and 3.0mm thick aluminium expansion sleeve / tube, and the expansion gap shall not be more than 10 mm. The Expansion joint must be properly sealed all around with weather sealant to make it water tight.

x) Gaps up to 10 mm between the peripheral aluminium member (end mullion) and masonry / R.C.C. / Stone shall be sealed by inserting adequate size of backer rod and weather silicon. Wherever the gaps are expected to be more than 10 mm, shall be sealed by providing and fixing of 2mm thick aluminium sheet flashings bent to required profile as per site, aluminium flashing sheet shall be pure polyester powder coated to 60 Micron thickness in approved shade / colour or as per instruction of E.I.C.. Detailed drawing of the flashings to be submitted by the contractor as per the site conditions for the approval of Engineer-in-charge.

xi) All Screws, Bolts, Nuts and Washers used in the glazing shall be only stainless steel (S.S. grade 304) and of approved make.

xii) Guaranty of adhesion for weather / structural silicones used for ACP cladding / glass fixing with aluminium framing works shall be submitted by the contractor to cover all risks against any failure of glass for a period of 10 years to Engineer in charge on completion of the works.
The Hermetically sealed double glass unit shall be fixed to an aluminium sub frame with approved make / grade of structural silicone of required bite (structural silicon bite size shall not be less than 8mm) OR as per structural requirement / as per manufacturers recommendations (28mm thick glass unit shall be glazed in controlled factory conditions) with 6.4 mm thick double adhesive Norton tape around the periphery of the glass unit and then glass unit shall be mounted on the curtain glazing main frame. All the glass panel joints in elevation shall be filled with approved grade of weather silicon with appropriate size of backer rod, using masking tape to avoid any stains of silicon on glass / aluminium framing, joints shall be uniform in concave shape in both vertical and horizontal directions and gap between two glass panels shall not exceed 16mm in width as shown in drawings and details OR as per instructions of site in charge. All the glass to glass joints in elevation shall be filled with approved grade of weather silicon with appropriate size of backer rod, using masking tape to avoid any stains of silicon on glass / aluminium framing, joints shall be uniform in concave shape / tool finish in both vertical and horizontal directions and gap between two glass panels shall not exceed 16mm / as shown in enclosed details OR as per instructions of Engineer-In-Charge.

The above work shall be carried out by approved specialized Agency to the satisfaction of Engineer-in-Charge.

**DGU Vision glass panels** - Hermetically sealed insulated glass units size shall be as per design / drawing and consisting of 28mm thick D.G.U. (Outer 6mm thick high performance toughened clear glass + 16mm thick air gap + Inner 6mm thick toughened clear glass) The standard glass panel shall be of size of 3000mm c/c in width and 900mm c/c in height, free from any scratch. All the glasses shall be installed in position with peel off protective tape. The protective tape shall be removed from installed glass after completion of project or as per instructions of Engineer-In-Charge.

**Module / Size of glass panel – 3000mm x 900mm**

**MATERIAL**

1) **CLEAR FLOAT GLASS**

Float glass used for glazing shall be of approved quality conforming to ASTM C 1016 for clear and ASTM 1048 for toughened glass and of the thickness specified in the item. The tolerance in thickness shall be ± 0.06 mm for 4mm to 6mm.

2) **TEMPERED / TOUGHENED GLASS**

Float glass conforming to BS 952 Part – I for clear and of the thickness specified in the item shall be used for manufacturing toughened glass. Toughening, which shall be carried out horizontally (without tong-marks), shall conform to ASTM 1048.

All works such as cutting, grinding, drilling etc. on glass shall be carried out prior to toughening. Once tempering is done, no work will be allowed on the glass.

3) **DOUBLE GLASS UNITS/ INSULATED GLASS UNITS (DGU/IGU)**

Double-glazed units (DGU) or insulated glass units (IGU) as per ASTM 774 shall consist of two parallel glass panes assembled with a metal (aluminium spacer and a dual seal to form a hermetically sealed unit. The insulation shall be achieved by trapping and creating of a cavity of dry air between the two panes of glasses.
The Aluminium spacer tubes shall contain specified absorbent (desiccant) to absorb moisture from within the glass panes cavity & the air. The pore size on aluminium spacer shall be as per manufacturer’s specifications. The aluminium spacer tube on all four sides shall be filled with desiccant.

The dual seal construction shall have a primary vapour seal made of compressed POLYISOBUTYLENE (BUTYL) and the outer seal shall be constructed with an elastic sealant based on structural silicone sealant. The inner seal is to be hot applied and should be plastic in nature which will fix the spacer – bar to the glass and reduce the moisture vapour ingress into the dry air cavity to the very minimum level.

The outer structural silicone sealant is cold applied and should be plastic and is to be chemically reactive material which bonds to the glass and cures to an elastic mass. The outer sealant should be able to do following functions.

- The bonding of glass panes and spacer to one another to from the insulating glass unit (IGU).
- Protection against chemical attack from outside (weather proof).
- Resistance against water entry either in fluid or vapour from.

The Aluminium spacer shall be 16 mm thick to give a dry air gap of 16 mm. The D.G.U. unit shall have a nominal thickness of 28 mm.

Float glass of international quality conforming to ASTM 774 for clear glass and of the thickness specified in the item shall be used for making insulated glass. The processing is done on specialized automatic machines in a dust-free air-conditioned plant.

4) HIGH PERFORMANCE TOUGHENED GLASS:-

High performance toughened glass shall have the following properties.

The high performance glass shall be heat reflective having mentioned properties with solar control (SF- 0.20 to 0.25) as well as thermal control with U values (1.30 to 1.60 w/sqm.k ), high light transmission properties (30% to 40%) with internal reflection (12 to 17%) and external reflection (15 to 20%).

5) POWDER COATING

Powder Coating of Aluminum Profile to be done having a minimum thickness of 50 microns using Super durable Interpon D 1000 powder of Akzo Nobel Coatings confirming to (American Architectural Manufacturer Association) AAMA2603 –2002 , BS6496 ,AS3715 , GB5237 and 1 year Florida Specification with 10 years Guarantee against Peel Off , Film Integrity and Gloss Retention . Coating to be done through Approved applicator of Akzo Nobel who has been carefully selected , audited for their quality management system, samples evaluated for the different specification and then certified as accredited applicator.

6) E.P.D.M. GASKETS

Heavy duty, best quality of EPDM gaskets shall be used over the structural glazing to fix vertical architectural aluminium fins at vertical joints as per drawings enclosed. EPDM gasket should be having its property to last at-least for minimum 10 -12 years, during this time it should not lose its property of elasticity and should not become brittle or plastic. It should be manufactured as per ASTM standards recommended and adopted worldwide.
Mechanical Properties:-
Hardness, Shore A Durometer - 40A - 90A
Tensile Strength Mpa - 7 - 21
Compression Set B% - 20 – 60
Density - 0.90 to > 2.00 gcm3
Abrasion Resistance - 450mm3

Thermal Properties:-
CTE, Linear 68 F - 576 um/m- C
Maximum Service Temperature, Air - 150 C
Minimum Service Temperature, Air - 54 C
Glass Temperature - 54 C

7) SPACER TUBE
Spacer tube shall be open cell (Norton or approved equivalent). The material is half softened and it can minimize the damage arising from extreme joint movement. It is coated by strong adhesive on both sides and while fabricating a glass unit due to its flexible advantage the things get done in proper way. It helps in site assembly, it is continuous cellular type of hard foam therefore it accelerates the hardening of silicon sealant by air and moisture circulation.

Density - 0.5g/cm3
Harden - 35 shore A
Tensile strength - 7.0 kg/cm3
Elongation - 80 %
Tensile Adhesive strength - 4.2kg/cm3
Shear Adhesive strength - 2.8kg/cm3
UC Test (60 C, 200 hours) - No colour change

8) WEATHER SILICON
Weather sealant should have minimum tearing strength 4.0N/mm, shore hardness 20 (ISO 868), joint movement capability +15% (As per ASTM C-920), one part natural cure. The sealant shall be DOW CORNING (GRADE-995) or equivalent. The silicon weather proofing sealant is designed for sealing expansion and control joints, pre cast panel joints, non structural curtain wall mullion joints.

9) STRUCTURAL SILICON
Structural sealant should have minimum tearing strength 6.0N/mm, Shore A hardness 44(ISO 868), Tensile strength (ISO 8339-A) 1.06 N/mm2 and one part joint movement capability _+ 25% (As per ASTM C-920), one part natural cure equivalent to (SG18 of Sikka wackers Or Dow Corning-995 or GE silicones).

EXECUTION

GLAZING WORK
The standard size of glass panels shall be (3000mm x 1225mm) or as shown in the drawings and thickness specified in the item of approved quality and make shall be installed in position. They shall have properly squared corners and straight edges. Damaged or defective glass shall be replaced with new glass at no additional cost. Each piece of glass shall be delivered with factory labels intact, indicating glass type, quality and thickness. Labels shall not be removed until installation has been accepted.

Setting blocks shall be of hard P.V.C. They shall be high enough to provide minimum edges clearance for glass. Glass is to be protected from breakage immediately upon installation by applying suitable warning markings.

All components should be sealed for water proofing with silicon of (Wacker Sika-305 or DOW corning DC-789 make or GE silicones) joint movement minimum + 50% according to ASTM C-920.

**REPLACEMENT OF GLASS**

In case of glass breakage during installation & testing, the glass will have to be replaced by deglazing the glass at site & the re-glazing of the new glass will have to be done at site without any extra cost up to defect liability period.

**FINAL CLEANING**

Protective coating and warning markings shall remain undisturbed until final acceptance. Immediately prior to final inspection, temporary protective covering or coating shall be removed and surfaces shall be washed with a suitable thinner and left in a finished condition having approved uniform appearance and free from all marks and blemishes. Both faces of the glass shall be washed and polished.

**INSPECTION**

If desired by E. I. C., agency should arrange for factory inspection of Aluminium section and glass to ascertain the quality of material i.e. aluminium and glass as per manufacturer's standard / BIS / ASTM standard, including anodizing / P.P.C., toughening of glass as per specification and standards for every 500 sqm or part thereof.

**HANDLING & STORAGE**

Glass shall be securely and safely crated for delivery, handling and storage. Cushions shall be provided at edges of glass to prevent damage. Glass faces shall be protected from scratches and abrasions. It shall be stored in a dry, well-ventilated location, carefully protected at all times from soiling, atmospheric.

**TESTS**

a) The aluminium shall be of grade confirming to alloy 63400 WP with chemical composition and mechanical properties as per IS:733:1983 and IS 1285:2002. One sample of each section shall be checked for aluminium alloy content for every 1000 kg or part thereof.

b) The aluminium shall be pure polyester Powder coated to 60 microns as per IS: 1868. The same shall be tested for 1000.00 kg or part thereof.

c) Float glass shall confirm to BS 952 part – 1 for clear glass. The thickness of glass shall be checked at any stage.
d) The system shall be tested in an approved independent laboratory at conditions prevalent at CUJ site for minimum 2000 Pascal wind load for Water and air penetration according to the centre for Windows and Cladding Technology (CWCT) standard USA at 600 Pascal pressure. The max. Deflection in the system should be not more than L/175.

e) The cost of all testing shall be borne by the contractor.

Item No. 12.07

Providing, supplying and fixing of Frameless Swing Glass Door in glazing using 12mm thick toughened glass of Saint Gobain / or approved equivalent with DORMA/ Geze/ Ozone make die cast patch fitting with stainless steel cover including fixing of patch fittings, floor springs, locks, handles etc. using the hardware items as detailed, complete in all respects as per detailed drawings, manufacturers specifications and direction of Engineer in charge.

Single Leaf:- Swing Glass Door which includes one no each of Top Pivot PT 24, Bottom Patch PT 10 , Top Patch PT 20, Floor Lock US 10,Floor Spring BTS 75V, pair of TGDIH SS Pull Handle 25 mm dia x 450 mm long and other accessories for self closing feature.

12.07.1 FRAMELESS GLASS DOORS

Dorma PT standard frameless glass door shall consist of Diecast Patch fittings with stainless steel covers and corner lock with euro profile cylinder. The rugged internal component of lock meet all the requirements of DIN 18251, class 3, satisfying the type test criteria of 2,00,000 latch and 50,0000 dead bolt operating cycle.

The fully closed zinc die-casting lock case ensure enhanced protection.

The fittings will be mounted on 12 mm toughened glass door with all necessary required accessories. The door will also consist of floor spring BTS-84 with all necessary glass mounting accessories for the self closing feature complete as per manufacturers specifications. The door shall also consist Dorma TG Pull Handle 350 mm
SECTION –B - TECHNICAL SPECIFICATIONS FOR PLUMBING WORK

A) SCOPE OF WORK

1.1 Work under this contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely furnish all the Plumbing and other specialized services as described hereinafter and as specified in the Schedule of Quantities and/or shown on the Plumbing Drawings.

This contract is an Item Rate Contract. All payments are made for the actual work executed. Any variation in the quantities will not have any extra cost implication on the quoted rates.

1.2 Without restricting to the generality of the foregoing Sanitary installations shall include the following:

a) Sanitary Fixtures & Fittings
b) Soil, Waste, Rain Water and Vent Pipes.
c) Water Supply System (Cold Water supply, hot water supply, flushing water supply)
d) Sewerage & Storm Water Drainage System
e) Soft Water Generation System
f) Drinking water RO and Chiller System
g) Solar Hot water Generation System

1.3 Services rendered under sub-section 1.4 shall be done without any extra charge.

1.4 The Contractor must get acquainted with the proposed site for the works and study Specifications and Conditions carefully before tendering. The work shall be executed as per programme approved by the Engineer-In-Charge / Owner. If part of site is not available for any reason or there is some unavoidable delay in supply of materials stipulated by the Owner, the programme of construction shall be modified accordingly and the Contractor shall have no claim for any extras or compensation on this account.

a) Works area shall be the area shown in the plan.

B) SPECIAL CONDITIONS OF CONTRACT

1. LICENSE AND PERMITS

1.1 Contractor must hold a valid Plumbing license issued by the Municipal Authority or other competent authority under whose jurisdiction the work falls.

1.2 Contractor must keep constant liaison with all relevant authorities and shall be responsible for obtaining all approvals relating to water supply, sewerage, storm-water drainage system including rainwater harvesting complete.
1.3 Contractor shall obtain No Objection Certificate before commencement of work, from the local authorities all related to his work as required for the building.

1.4 Contractor shall obtain, from the local authorities all related completion certificates with respect to his work as required for occupation of the building.

1.5 No additional charges other than official payment shall be payable to the contractor on getting NOC / completion certificate/Inspection fees. Unless it is obtained, the final payment of the contractor shall not be released.

2. **METRIC CONVERSION**

2.1 All dimensions and sizes of materials and equipment given in the tender document are commercial metric sizes.

2.2 Any weights, or sizes given in the tender having changed due to metric conversion, the nearest equivalent sizes accepted by Indian Standards shall be acceptable without any additional cost.

3. **REFERENCE POINTS**

3.1 Contractor shall provide permanent Bench Marks, Flag Tops and other reference points for the proper execution of work and these shall be preserved till the end of the work.

3.2 All such reference points shall be in relation to the levels and locations given in the Architectural and Plumbing drawings.

4. **GENERAL INSTRUCTIONS**

4.1 All works specified in the tender have to be executed in accordance with:

   a) The rules and regulations of Local Authority Having Jurisdiction, and as per the statutory regulations applicable.

   b) Applicable norms laid down by the relevant sections of latest editions of National Building Code (NBC) and all relevant codes of Bureau of Indian Standards (B.I.S.) shall be followed as applicable.

   c) The codes of the Uniform Plumbing Code of India and relevant British Standards shall be used as a general guide for good engineering practice, design and workmanship norms.

4.2 All materials used in the works shall have Bureau of Indian Standards valid certification stamped, marked or cast on the material in an acceptable and approved manner, as specified hereinafter.

4.3 It is the contractor's responsibility to ensure the competence of design to meet the above requirements.

(i). Drawings issued with the tenders are schematic and indicate the concept. Contractor shall make his shop drawings on basis of Architectural and Interior design drawings issued by the Engineer-in-Charge. Work will be executed only as per approved shop drawings.
4.5 Quantities in the tender document are approximate worked out on the tender drawing issued.

4.6 Contractors are invited to highlight any aspects of the contract document that may need revision or reconsideration before the work is started. He must furnish details of any variations in the specifications or the quantities that may be necessary for him to comply with the Code and statutory requirements. These may be identified and approval of the Project managers taken before the start of the work.

4.7 Contractors shall furnish detailed Shop drawings, hydraulic and other design calculations for approval.

4.8 Work under this contract shall be carried out strictly in accordance with Specifications attached with the tender.

4.9 Items not covered under these Specifications due to any ambiguity or misprints, or additional works, the work shall be carried out as per Specifications of the latest Central Public Works Department with latest amendments as applicable in the contract.

4.10 The work shall be carried out strictly as specified in Schedule of Quantities and Technical Specifications. In case of any ambiguity, the details of particular item as given in Schedule of Quantities shall supersede the details in Specifications.

5. **DRAWINGS ISSUED TO CONTRACTOR**

5.1 Plumbing drawings are diagrammatic but shall be followed as closely as actual construction permits. Any deviations made shall be in conformity with the Architectural and other services drawings.

5.2 Architectural drawings shall take precedence over Plumbing or other services drawings as to all dimensions.

5.3 Contractor shall verify all dimensions at site and bring to the notice of the Architects, all discrepancies or deviations noticed. Architects decision shall be final.

5.4 Large size details and manufacturers dimensions for materials to be incorporated shall take precedence over small-scale drawings.

5.5 All drawings supplied with the tender shall be returned in good conditions along with the tender.

5.6 All drawings/sketches issued by the Architects/Consultant for the works are the property of the Architects/Consultant and shall not be lent, reproduced or used on any works other than intended without the written permission of the Architects/Consultant.

5.7 The Contractor shall maintain one set of all drawings issued to him as reference drawings. These shall not be used on site.

All corrections, deviations and changes made on the site shall be shown on these reference drawings for final incorporation in the completion drawings. All changes to be made shall be initialed by the Engineer-In-Charge/Owner.
6. **SHOP DRAWINGS**

6.1 The Contractor shall submit to the Consultant two copies of Shop Drawings for Plumbing works as an Advance Copy to the Engineer-in-Charge for approval before start of work. Subsequent to the approval of the shop drawings, the Contractor shall submit seven copies of Shop Drawings for execution to the Engineer-in-Charge. The Contractor shall also submit four copies of the Technical Specifications and Catalogues for all items, including pump curves, single line diagrams etc. as relevant.

   a) All Sanitary Engineering drawings issued to the Contractor shall be studied by them. Contractor shall also obtain the necessary architectural, structural and other services drawings, based on which they shall prepare their shop drawings as per site conditions.

   b) Shop drawings shall incorporate the following:

      a) All proposed Structural supports/hanging/laying and jointing details for all types of pipes as required.

      b) Typical details for Toilets & Fixtures required.

      - Plumbing layout plans as required and for any changes in the layout of Plumbing/ Architectural Drawings.

      - Equipment & piping layout for Mechanical and Electrical equipments as required, SLDs, mounting details of circuit breakers, location of panels, installation of terminals and faucets etc. w.r.t. finishes, surrounding levels & locations.

      - Manufacturer’s and Contractor’s fabrication drawings

6.2 The Contractor can only commence the work after the approval of above documents by Project Manager/ Consultant.

6.3 Contractors shall ensure that the Shop drawings are approved by the Engineer-In-Charge / Owner / Consultant prior to any execution.

7. **COMPLETION DRAWINGS & DOCUMENTS**

7.1 On completion of work contractor shall submit one complete set of original tracings and two prints of “As Built” drawings for the Engineer-In-Charge. These drawings shall have the following information.

   a) Run of all pipes with diameters and length on all floors and vertical stacks.
   b) Ground and Invert levels of all Plumbing services pipes.
   c) Location of all valves.
   d) Location of all Mechanical equipment with layout and piping connection.
7.2 Contractor shall provide four sets of Test Certificate, Routine Type Test certificates for Motors, Dynamic balancing certificate for Impellers, Calibration certificate for instrument catalogues, Operation and Maintenance Manuals, performance data and list of spare parts supplied together with the name and address of the Manufacturers for all Mechanical and Electrical equipments provided by him in the form of a Book or Manual.

7.3 All “Warranty / Guarantee” cards / certificates in original issued by the manufacturers shall be handed over to the Engineer-In-charge also in the form of a comprehensive record book / documents.

8. MATERIALS (SUPPLIED BY THE CONTRACTOR)

8.1 All materials used in the works shall conform to the tender specifications.

8.2 As far as possible all materials shall be bearing I.S. certification marks as per approval of the Engineer-In-Charge.

8.3 All materials shall bear the necessary certification marks, conforming to the Tender Specifications / BOQ / Drawings requirements.

8.4 Unless otherwise specified and expressly approved in writing by the Engineer-In-Charge, materials of makes and specifications mentioned with tender shall be used.

9. INSPECTION AND TESTING OF MATERIALS

9.1 All materials before being allowed to be brought into the store will be preliminary / visually inspected at the entry gate of the project site before the security personnel. All materials shall be inspected by the Engineer-In-charge / Owner before receiving. This inspection will be conducted with the help of the quality approval format as prepared by the Clients.

9.2 Contractor shall be required, if requested, to produce manufacturers Test Certificate for the particular batch of materials supplied to him. The tests carried out shall be as per the relevant Indian Standards.

9.3 For examination and testing of materials and works at the site Contractor shall provide all Testing and Gauging Equipment necessary but not limited to the followings:-

- Theodolite
- Dumpy level
- Steel tapes
- Weighing machine
- Plumb bobs, Spirit levels, Hammers
- Micrometers
- Thermometers, Stoves
- Hydraulic test machine
- Smoke test machine

9.4 All such equipment shall be tested for calibration at any approved laboratory, and the test and calibration certificate shall be submitted to the Engineer-In-Charge / Owner.
9.5 All Testing Equipment shall be preferably located in special room meant for the purpose.

10. MATERIALS SUPPLIED BY THE OWNER

10.1 The Contractor shall verify that all materials supplied by the Owner conform to the specifications of the relevant item in the tender. Any discrepancy found shall be brought to the notice of the Engineer-In-Charge.

10.2 After receipt of materials, it shall be the responsibility of the Contractor for any damage found and he shall be liable to pay the actual cost of the material as per market rate at that time.

11. RECOVERY OF COST FOR MATERIALS ISSUED TO CONTRACTORS FREE OF COST

If any materials issued to the Contractor, free of cost, are damaged or pilfered, the cost of the same shall be recovered from the Contractor on the basis of actual cost to the Owner which shall include all freight and transportation, excise duty, sales tax, octroi, import duty etc. or the actual cost given by the Owner shall be final and binding on the Contractor.

12. CONTRACTORS RATES

12.1 Rates quoted in this tender shall be inclusive of cost of materials, labor, supervision, erection, tools, plant, scaffolding, service connections, transport to site, taxes, octroi and levies, breakage, wastage, sales tax on works contract and all such expenses as may be necessary and required to completely do all the items of work and put them in a working condition.

12.2 Rates quoted are for all heights and depths required for this work.

12.3 All rates quoted must be for complete items inclusive of all such accessories, Fixtures and fixing arrangements, nuts, bolts, hangers as are a standard part of the particular item except where specially mentioned otherwise.

12.4 All rates quoted are inclusive of cutting holes and chases in walls and floors and making good the same with cement mortar/concrete of appropriate mix and strength as directed by Engineer-In-Charge. Contractor shall provide holes, sleeves and recesses in the concrete and masonry work as the work proceeds.

12.5 Rates quoted shall be inclusive of cost incurred in testing, commissioning of works and materials.

12.6 The items not covered in BOQ shall be paid extra after getting the approval from Engineer-In-Charge / Owner. The rate analysis considering Cost Price, Labor, 10% (Ten percent) along with supporting documents / bills etc., shall be submitted to Engineer-In-Charge / Owner for approval.
13. **MOCK UP AND TRIAL ASSEMBLY**

The installation of Sanitary Fixtures and fittings shall be as per the shop drawings approved by Architect / Consultant.

The Contractor shall have to assemble at least one set of each type of Sanitary Fixtures and Fittings in order to determine precisely the required supply and disposal connections. Relevant instructions from manufacturers shall be followed as applicable. This trial assembly shall be developed to determine the location of puncture holes, holding devices etc, which will be required for final installation of all Sanitary fixtures and fittings. The above assembly shall be subject to final approval by the Architect / interior designers.

The Fixtures in the trial assembly can be reused for final installation without any additional payments for fixing or dismantling of the fixtures.

14. **EXECUTION OF WORK**

14.1 The work shall be carried out in conformity with the Plumbing drawings and within the requirements of Architectural, HVAC, Electrical, Structural / Green Building consultant and other specialized services drawings.

14.2 The Contractor shall cooperate with all trades and agencies working on the site. He shall make provision for hangers, sleeves, structural openings and other requirements well in advance to prevent hold up of progress of the construction programme.

14.3. On award of the work, Contractor shall submit a programme of construction in the form of a Pert Chart or Bar Chart for approval of the Engineer-In-Charge / Owner. All dates and time schedule agreed upon should be strictly adhered to, within the stipulated time of completion/commissioning along with the specified phasing, if any.

14.4 Contractor shall be responsible for co-ordination with other agencies working on the project relating to their scope of work and shall take approval from the Engineer-In-Charge / Owner wherever required.

14.5 **Cutting & Making Good**

No structural member shall be chased or cut without the written permission of the Engineer-In-Charge.

15. **TESTING**

15.1 Piping and drainage works shall be tested as specified under the relevant clauses of the specifications.

15.2 Tests shall be performed in the presence of the Engineer-In-Charge / Consultant.

15.3 All materials and equipment found defective shall be replaced and whole work tested to meet the requirements of the specifications.

15.4 Contractor shall perform all such tests as may be necessary and required by the local authorities to meet Municipal or other by-laws in force.
15.5 Contractor shall provide all labour, equipment and materials for the performance of the tests.

15.6 Contractor shall afford all the expenses for the offsite testing of material and equipments.

15.7 All appliances, fixtures and fittings shall be tested before and after installation. Water seals of all appliances shall be tested. The Contractor shall block the ends of waste and ventilation pipes and shall conduct air test.

16. **SITE CLEARANCE AND CLEANUP**

16.1 The Contractor shall, from time to time clear away all debris and excess materials accumulated at the site.

16.2 After the Fixtures, equipment and appliances have been installed and commissioned, Contractor shall clean-up the same and remove all plaster, paints stains, stickers and other foreign matter of discoloration leaving the same in a ready to use condition.

16.3 On completion of all works, Contractor shall demolish all stores, remove all surplus materials and leave the site in a broom clean condition, failing which the same shall be done at Contractors risk and cost.

17. **FINAL INSTALLATION**

The Contractor shall install all Sanitary fixtures and fittings in their final position in accordance with the approved trial assemblies and as shown on the Drawings. The installation shall be complete with all supply and waste connections. The connection between building and piping system and the sanitary fixtures shall be through proper unions and flanges to facilitate removal / replacement of Sanitary Fixtures without disturbing the built in piping system. All unions and flanges shall match in appearance with other exposed fittings.

Fixtures shall be mounted rigid, plumb and true to alignment. The outlet of water closet pans and similar appliances shall be examined to ensure that outlet ends are butting and the receiving pipes before making the joint. It shall be ensured that the receiving pipes are clear of obstruction. When Fixtures are being mounted, attention shall be paid to the possibility of movement and settlement by other causes. Overflows shall be made to ensure that necessary anchoring devices have been provided for supporting water closets, wash basins, sinks and other appliances.

18. **PROTECTION AGAINST DAMAGE**

The Contractor shall take every precaution to protect all Sanitary fixtures against damage, misuse, cracking, staining, breakage and pilferage by providing proper wrapping and locking arrangement till the completion of the installation and handling over. At the time of handling over, the Contractor shall clean, disinfect and polish all the fixtures and fittings. Any Fixtures found damped, cracked, clipped, strained or scratched shall be removed and new fixtures and fittings free from defects shall be installed at his own cost to complete the work.
19. **GUARANTEE / WARRANTY**

19.1 The contractor shall submit a warranty for all equipment, materials and accessories supplied by him against manufacturing defects, malfunctioning or under capacity functioning.

19.2 The form of warranty shall be as approved by the Engineer-in-charge.

19.3 The warranty shall be valid for a period of one year from the date of commissioning and handing over.

19.4 The warranty shall expressly include replacement of all defective or under capacity equipment. Engineer-in-charge may allow repair of certain equipment if the same is found to meet the requirement for efficient functioning of the system.

19.5 The warranty shall include replacement of any equipment found to have capacity lesser than the rated capacity as accepted in the contract. The replacement equipment shall be approved by the Engineer-in-charge.

19.6 The contractor shall include in his rates the operation of all mechanical equipment for a period of one month from the date of commissioning. No separate payment will be made on this account.

C) **SANITARY FIXTURES**

1. **SCOPE OF WORK**

1.1 Work under this section shall consist of furnishing all Material and labor as necessary and required to completely install all Sanitary Fixtures, brass and chromium plated fittings and accessories as required by the drawings and specified hereinafter or given in the Schedule of Quantities.

1.2 Without restricting to the generally of the foregoing the Sanitary Fixtures shall include all Sanitary Fixtures, C.P. fittings and Accessories etc. necessary and required for the Building.

1.3 Whether specifically mentioned or not all Fixtures and appliances shall be provided with all fixing devices, nuts, bolts, screws, hangers as required.

2. **GENERAL REQUIREMENTS**

2.1 All Fixtures and fittings shall be provided with all such accessories as are required to complete the item in working condition whether specifically mentioned or not in the Schedule of Quantities, Specifications and Drawings.

2.2 All Fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per Architectural/ Interior designer’s requirements. Wherever necessary the fittings shall be centered to dimensions and pattern desired.

2.3 Fixing screws shall be half round head Chromium Plated brass with C.P. washers wherever required as per directions of Engineer-in-Charge / Owner.
2.4 All Fittings and Fixtures shall be fixed in a neat workmanlike manner true to Levels and Heights shown on the drawings and in accordance with the manufacturer’s recommendations. Care shall be taken to fix all Inlet and Outlet Pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, tiling or terrace shall be made good at Contractors cost.

2.5 When directed, Contractor shall install Fixtures and accessories in a mock-up room for the approval of the Engineer-in-Charge/Owner. Sample room Fixtures may be reused on the works if undamaged, but no additional payment for fixing or dismantling shall be admissible.

2.6 APPLICABLE CODES
   - IS: 2556 - Vitreous Chinaware Sanitary Appliances
   - IS: 774 - Flushing Cistern for water closets & urinals (other than plastic cisterns)
   - IS: 2326 - Automatic Flushing Cisterns for urinals (other than plastic cisterns)
   - IS: 2548 (Part 1 & 2) - Plastic seats for water closets

3. EUROPEAN W.C.
   3.1 European W.C. shall be wash down, single or double siphonic type, wall mounted set, flushed by means of exposed or concealed type flushing cistern or flush valve, as specified in Schedule of Quantities. Flush pipe/bend shall be connected to the W.C. by means of suitable rubber adapter. Wall hung W.C. shall be supported by C.I. floor mounted chair.
   3.2 Each water closet shall have an integral “P” trap with at least 50 mm water seal.
   3.3 The inside surface of W.C. & Traps shall be uniform and smooth in order to enable smooth and efficient flush.
   3.4 Each W.C. seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C.

4. WASH BASIN
   4.1 Wash basins shall be white glazed vitreous china of size, shape and type specified in the schedule of quantities.
   4.2 Wash Basins shall be either counter top or under-counter or as specified in the schedule of quantities.
   4.3 Each Basin shall be provided with 32 mm dia CP Waste coupling with overflow, pop-up waste or as specified in the Schedule of quantities.

5. URINALS
   5.1 Urinals shall be white glazed Vitreous China flat back half stall or lip type as specified in Schedule of Quantities.
   5.2 Urinals shall be provided with 15 mm dia C.P. spreader, 32 mm dia C.P. domical waste and C.P. cast brass bottle trap with pipe and wall flange.
5.3 Urinals shall be flushed by means of automatically sensor operated flushing system as specified in Schedule of Quantities.

5.4 Waste pipes for urinals shall be of the following:

(a) **G.I. Pipes**

Waste pipes may be exposed on wall or concealed in chase as directed by the Engineer-in-Charge / Owner. Specifications for waste pipes shall be same as given in Sub Section.

6. **SINKS**

6.1 Sinks shall be of precast Terrazzo marble or White Glazed fire clay or vitreous china or stainless steel or any other material as specified in the Schedule of Quantities.

6.2 Hand Wash Sinks and Process Sinks shall be of stainless steel with or without Drain board and may be supplied by the Owner.

6.3 Each sink shall be provided with R.S. or C.I. brackets and clips and securely fixed. Counter top sinks shall be fixed with suitable angle iron clips or brackets as recommended by the manufacturer. Each sink shall be provided with 40 mm dia C.P. waste with chain and plug or P.V.C. waste. Fixing shall be done as directed by Engineer-in-Charge / Owner.

6.4 Supply fittings for sinks shall be mixing fittings or C.P. Censor Operated (Battery/Electrical) taps as specified in the Schedule of Quantities.

7. **SHOWER SET**

7.1 Shower set shall comprise of single lever mixer or four way diverter with two C.P. brass concealed stop cocks, with bath spout or as given in the Schedule of Quantities.

7.2 Each shower set shall also be provided with C.P. shower arm with wall flange and shower head of approved quality or as specified in the Schedule of Quantities.

7.3 Concealed stopcocks shall be so fixed as to keep the wall flange clear off the finished wall. Wall flanges embedded in the finishing shall not be accepted.

8. **ACCESSORIES**

8.1 Contractor shall install all Chromium Plated and porcelain accessories as shown on the drawings or directed by Engineer-in-Charge / Owner, and given in the Schedule of Quantities.

8.2 All C.P. Accessories shall be fixed with C.P. brass half round head screws and cup washers in wall with raw plugs or nylon sleeves and shall include cutting and making good as required or directed by Engineer-in-Charge/Owner.

8.3 Porcelain accessories shall be fixed in walls and set in cement mortar 1:2 (1 cement: 2 coarse sand) and fixed in relation to the tiling work.

9. **URINAL PARTITIONS**

9.1 Urinal partitions shall be white glazed vitreous china or 25mm thick marble of size specified in the Schedule of Quantities.
9.2 Porcelain partitions shall be fixed at proper heights with C.P. brass bolts, anchor fasteners and M.S. clips as recommended by the manufacturer and directed by Engineer-in-Charge / Owner.

10. **PAN CONNECTOR**

The WC pan connector shall be Flexible, soft and shall be made of single body construction with integral fins. The pan connector must be supplied with factory fitted spring loaded seal guard.

While fixing of the pan connector with the Soil pipe, the pipe must be reasonably clean and smooth on the inner surface; in case the soil piping is in C.I. then supplier supplied bush / adaptor shall be used. The connector socket is pushed fully home onto the pan spigot, thereafter the WC is placed in position gently pushing the fitment to ensure that the connector end fits into the Spigot of the pipe. The pan connector must be pushed in such a easy as to ensure that the seals and fins turn inward to ensure proper sealing.

11. **MEASUREMENT**

11.1 Rates for fixing of Sanitary Fixtures Accessories, urinal partitions shall include all items and operations stated in the respective specifications and Schedule of Quantities and nothing extra is payable.

11.2 Rates for all items under specifications above shall be inclusive of cutting holes and chases and making good the same, C.P. screws, nuts, bolts and any fixing arrangements required and recommended by Manufacturers, Testing and Commissioning.

D) **SOIL, WASTE & VENT PIPES**

1. **SCOPE OF WORK**

1.1 Work under this section shall consist of furnishing all labor, materials, equipments and appliances necessary and required to completely install all soil, waste, vent and rainwater pipes as required by the drawings, specified hereinafter and given in the Schedule of Quantities.

1.2 Without restricting to the generally of the foregoing, the soil, waste, vent and rainwater pipes system shall include the followings:

   a) Vertical and horizontal Soil, Waste and Vent Pipes, Rainwater Pipes and Fittings, Joints Clamps and connections to Fixtures.
   b) Connection of pipes to Gully Traps & Manholes etc.
   c) Rain water pipes as specified
   d) Testing of all pipes.

2. **GENERAL REQUIREMENTS**

2.1 All materials shall be new of the best quality conforming to specifications and subject to the approval of Engineer-in-Charge / Owner.

2.2 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
2.3 Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

2.4 Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.

2.5 Access doors for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance.

2.6 All works shall be executed as directed by Engineer-in-Charge / Owner.

3. CAST IRON PIPES & FITTINGS

3.1 Pipes

(a) All pipes shall be straight and smooth and inside free from irregular bore, blowholes, cracks and other manufacturing defects. Pipes shall be sand cast iron pipes conforming to I.S: 1729-1967 or centrifugally cast (spun) iron pipes conforming to I.S:3989 as specified in Bill of Quantities.

(b) Tolerance
Acceptable tolerance for pipes to I.S: 3989 shall be as follows:-

- Wall thickness - 15%
- Length +20 mm
- Weight - 10%

3.2 Fittings

(a) Fittings shall conform to the same Indian Standard. The Contractor shall use pipes and fittings of matching specifications.

(b) Fittings shall be of the required degree of curvature with or without access doors.

(c) Access door shall be made up with 3mm thick insertion rubber washer and white Lead. The bolts shall be lubricated with grease or white Lead for easy removal later. The fixing shall be air and watertight.

3.3 Fixing

(a) All vertical pipes shall be fixed by M.S. clamps truly vertical. Branch pipes shall be connected to the stack at the same angle as that of the fittings. No collars shall be used on vertical stacks. Each stack shall be terminated at top with a Cowl (terminal guard).

(b) Horizontal pipes running along ceiling shall be fixed on structural adjustable clamps of special design shown on the drawings or as directed. Horizontal pipes shall be laid to uniform slope and the clamps adjusted to the proper levels so that the pipes fully rest on them.

(c) Contractor shall provide all sleeves, openings, hangers, inserts during the construction. He shall provide all necessary information to the building Contractor for making such provisions in the structure as necessary. All damages shall be made good to restore the surface.
3.4 Jointing

C.I pipes wherever used shall be jointed with refined pig lead conforming to IS: 27-1977 or Drip Seal PJS -43.

(a) Pig Lead Joint

A sufficient skein or jute rope shall be caulked to leave a minimum space for the pig lead to be poured in. After pouring the lead shall be caulked into the joint with caulking tool and hammer. All surplus lead shall be cut and joint left flush with the rim of the socket neatly.

Standard weight, dimensions and pig lead required for joints shall be as follows:

For pipes conforming to I.S: 3989 (sand cast iron soil pipes and fittings)

<table>
<thead>
<tr>
<th>Nominal Dia (MM)</th>
<th>Thickness (MM)</th>
<th>Overall Weight for 1.8 m long pipe (Kg.)</th>
<th>Minimum depth of lead joint from the lip of socket (MM)</th>
<th>Quantity of lead per Joint (Kg.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>5</td>
<td>11.41</td>
<td>25</td>
<td>0.50</td>
</tr>
<tr>
<td>75</td>
<td>5</td>
<td>16.52</td>
<td>25</td>
<td>0.66</td>
</tr>
<tr>
<td>100</td>
<td>5</td>
<td>21.67</td>
<td>25</td>
<td>1.00</td>
</tr>
<tr>
<td>150</td>
<td>5</td>
<td>31.92</td>
<td>38</td>
<td>1.25</td>
</tr>
</tbody>
</table>

4. HDPE Pipes

4.1 HDPE Pipes for disposal of Waste water of the Labs. These pipes are available in PN 2.5 to PN 16 Pressure class in PE63, PE 80 and PE 100 grades.

4.1.1 HDPE Jointing

HDPE pipes are to be jointed by Butt fusion welding method with the help of electric heating mirror and hydraulically / mechanically operated Welding jack.

The two ends of the pipes to be welded are cut perpendicular to the pipe’s axis, cleaned and planed. The pipes are fixed in welding jack. The pipes shall be pressed against Teflon coated Hot mirror till a bead of molten material is framed. The mirror is removed & hot pipe ends are jointed & kept in position firmly straight for some time till the joint is formed.

The mirror shall be electrically heated by in-built electric resistance heating coil. The temperature of surface of mirror shall be automatically maintained within the required limit i.e. $200 \pm 10^0$ C.
5. **UPVC PIPES (I.S. 4985)**

5.1 4/6/10 kg/cm² Class selection shall be as per BOQ.

All fittings for uPVC pipes up to 200 mm O.D. size shall be injections moulded as per manufacturer, confirming to IS: 4985 and as specified in bill of quantities.

5.2 For Fittings of sizes which are not injection moulded but fabricated (Locally/Imported) sample of the same shall be submitted for approval.

5.3 **Handling Guidelines**

Pipes should be kept on an even surface while storing. They should be properly supported and should not be stacked for heights more then 1.5 meters for longer duration.

5.4 **Jointing Instructions**

The uPVC Pipes are of two types i.e. Selfit and Ringfit. The following procedure may be adopted while jointing the Pipes:

(a) **Selfit Pipes**

- Cut the Pipes as square as possible and ensure fitment of Pipes with socket of fitting is correct. Total length of insertion of sockets to be marked from the Pipe.
- The Pipe and the socket should be clean and dry. Dust, Oil, water, grease etc. should be wiped out with dry cloth or cleaner from the surfaces to be coated with Solvent Cement.
- Roughen the outside of Pipe and inside of Socket using sand Paper up to the entry mark. Stir adhesive i.e. Solvent Cement thoroughly.
- Apply thick coat of Solvent Cement using a flat clean brush evenly on the inside of the socket mouth for full length of insertion and then outside of the Pipe end up to the marked line.
- After application of Solvent Cement, insert the Pipe within one minute in to the Socket. Hold the Joint for few seconds and ensure that the Pipe does not come out of the fittings. Wipe off extra cement and allow it to dry for at least 24 Hours. The PVC Pipe with joint is ready for use.

<table>
<thead>
<tr>
<th>Diameter of Pipe (mm)</th>
<th>20</th>
<th>25</th>
<th>32</th>
<th>40</th>
<th>50</th>
<th>63</th>
<th>75</th>
<th>90</th>
<th>110</th>
<th>160</th>
<th>200</th>
<th>250</th>
<th>315</th>
<th>400</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approx. No: of joints which can be made per liter of Solvent cement</td>
<td>324</td>
<td>270</td>
<td>225</td>
<td>180</td>
<td>130</td>
<td>125</td>
<td>103</td>
<td>79</td>
<td>54</td>
<td>27</td>
<td>15</td>
<td>9</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

**Consumption of Solvent Cement**
(b) **Ring-fit Pipes**

- Clean the inside of Socket. Remove all traces of mud, dirt, grease, gravel and also clean sealing ring.
- Form the EPDM ring into heart shape by pinching a portion of ring inside. Insert it into the socket and release to seat in to the groove.
- Mark the insertion depth on spigot portion of the pipe. Clean and apply lubricant to insertion depth before pushing in to the Socket. Ensure that no sand or dirt adheres to the lubricated surface of the Pipe.
- Push the Spigot into the Socket until it reaches the depth of entry mark, taking care not to over insert. This can be done manually. Make sure that the insertion of Spigot end inside the socket should be at correct angle. The Pipe and Joint are ready for use.
- In case of large diameter Pipes if crow bar does not give sufficient leverage, use of jointing jack may be helpful.

**Precautions**

1. UPVC Pipes and Fittings should not be cleaned by Solvent Cement.
2. For large diameter and Higher class Pipes (6 kgf/cm² & above), use heavy duty Solvent cement.
3. UPVC pipes and fittings to be used of same Brand and Manufacturer.

6. **CLAMPS**

6.1 G.I. clamps shall be of standard design and fabricated from M.S. flat 40x3mm thick with required Galvanization.

6.2 Where G.I. clamps are to be fixed on RCC columns or slotted angles, walls or beam they shall be fixed with 40x3mm flat iron “U” type clamps with anchor fasteners of approved design or 6mm nuts and bolts.

6.3 Structural clamps shall be fabricated from G.I. (Galvanized) Structural members e.g. rods, angles, channels flats as per detailed drawing or as directed. Contractor shall provide all nuts, bolts, welding material and paint the clamps with one coat of red oxide and two or more coats of black Enamel paint. Wooden saddles, where required shall be provided free of cost.

6.4 Slotted angle/channel supports on walls shall be provided wherever shown on drawings. Angles/channels shall be of sizes shown on drawings or specified in Schedule of Quantities, angles/channels shall be fixed to brick walls with bolts embedded in cement concrete blocks and to RCC walls with suitable anchor fasteners. The spacing of support bolts horizontally shall not exceed 1 m.

6.5 Wherever G.I. clamps are required to be anchored directly to brick walls, concrete slabs, beams or columns, nothing extra shall be payable for clamping arrangement and making good with cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 mm stone aggregate 20mm nominal size) as directed by the Engineer-in-Charge / Owner.
7. **TRAPS**

7.1 Floor traps shall be either uPVC or Cast Iron, deep seal with an effective seal of 50 mm. The trap and waste pipes shall be set in cement concrete blocks firmly supported on the structural floor. The blocks shall be in 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) and extended to 40 mm below finished floor level. Contractor shall provide all necessary shuttering and centering for the blocks. Size of the block shall be 30x30 cm of the required depth. Where traps are suspended below ceilings, they shall be provided with proper structural supporting arrangements.

7.2 **Urinal Traps**

Urinal traps shall be either uPVC or Cast Iron deep seal traps with or without Vent and set in cement concrete block specified in Para above without extra charge.

7.3 **Floor Trap Inlet**

Bath room traps and connections shall ensure free and silent flow of discharging water. Where specified, Contractor shall provide a special type G.I. inlet hopper without or with one, two or three inlet sockets to receive the waste pipe. Hopper shall be connected to trap with at least 50 mm seal (Hopper and traps shall be paid for separately.)

7.4 **C.P./Stainless Steel Gratings**

Floor and Urinal Traps shall be provided with 100-150 mm square or round C.P/Stainless steel grating, with rim of approved design and shape. Minimum thickness shall be 4-5 mm or as specified in the Schedule of Quantities.

8. **CLEANOUT PLUGS**

Contractor shall provide brass cleanout plugs as required. Cleanout plugs shall be threaded and provided with key holes for opening. Cleanout plugs shall be fixed to the pipe by a male threaded adaptor.

9. **WASTE PIPE FROM APPLIANCES**

9.1 Waste pipe from appliances e.g. wash basins, sinks, urinals, bathtubs, water coolers shall be of galvanized steel/uPVC as given in the Schedule of Quantities or as shown on the drawings.

9.2 All pipes shall be fixed in gradient towards the outfalls of drains. Pipes inside a toilet room shall be in chase unless otherwise shown on drawings. Where required pipes may be run at ceiling level in suitable gradient and supported on structural clamps. Spacing for clamps for such pipes shall be as follows:-

<table>
<thead>
<tr>
<th></th>
<th>Vertical</th>
<th>Horizontal</th>
</tr>
</thead>
<tbody>
<tr>
<td>G.I pipes</td>
<td>300 cms</td>
<td>240 cms</td>
</tr>
</tbody>
</table>

Tech. Specification - 45
9.3 **Galvanized Iron Pipes**

Pipes shall be galvanized iron tubes conforming to IS: 1239-1979 (medium class) and quality certificates shall be furnished. Pipes shall be provided with all required fittings e.g. Tees, Couplings, Bends, Elbows, Unions, Reducers, Nipples, Plugs. All G.I. waste pipes shall be terminated at the point of connection with the appliance with an outlet of suitable diameter.

10. **CEMENT CONCRETE**

Cast Iron Soil and Waste pipes under floors in sunken slabs and in wall chases (When cut specially for the pipe) shall be encased in cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 12 mm size) 75 mm in bed and alround. When pipes are running well above the structural slab, the encased pipes shall be supported with suitable cement concrete pillars of required height and size at intervals as directed by Engineer-in-Charge/Owner.

11. **PAINTING**

11.1 Wherever CI pipes are used, it shall be painted with two or more coats of synthetic enamel paint to give an even shade. All surfaces shall be thoroughly cleaned before painting.

11.2 Paint shall be of approved quality and shade, pipes shall be painted in accordance with approved pipe color code.

11.3 Waste pipes in chase shall be painted with two coats of Bitumen paint, covered with polythene tape and a final coat of bitumen paint. Exposed pipes shall be painted with two or more coats of Synthetic enamel paint.

11.4 C.I. pipes below ground and covered in cement concrete shall not be painted.

12. **CUTTING AND MAKING GOOD**

Pipes shall be fixed and tested as buildings proceeds. Contractor shall provide all necessary holes cutouts and chases in structural members as building work proceeds. Wherever holes are cut or left originally, they shall be made good with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) or cement mortar 1:2 (1 cement: 2 coarse sand) and the surface restored as in original condition.

13. **INSPECTION & TESTING**

13.1 **Inspection**

Work should be inspected during installation and tests applied on completion, care being taken that, all work which is to be encased for concealed is tested before it is finally enclosed.

Inspection should be carried out to ensure the following:

(a) Work accords with the drawing and specifications.

(b) All pipe brackets, clips etc. are securely fixed.

(c) Fixtures are correctly spaced.
(d) Pipe is protected where necessary by Thermal Insulation.
(e) Embedded pipe work is properly protected before sealing-in
(f) All access covers, caps or plugs.
   • Are accessible
   • Are so made that the internal faces truly complete in internal bore.
   • Cause no obstruction in the pipe bore
   • Are well joined.

13.2 Testing

The soil, waste piping system and rain water should be tested after installation as follows:

(a) Water Test
The pipes shall be tested after installation & before the appliances are connected, preferably in sections so as to limit the static head of 4.5m. The pipe shall be filled with water for at least 10 minutes. After filling, pipes shall be struck with a hammer and inspected for blow holes and cracks. Then it will be necessary to seal all openings and leaks at joints immediately as observed during the test and all defective pipes shall be rejected and removed from the site. Pipes with minor sweating shall be accepted at the discretion of the Engineer-in-Charge/Owner.

(b) Smoke Test
Alternatively, the Contractor may test all Soil, Waste and Rainwater stacks by smoke testing machine. The smoke test shall be carried out as under:

Smoke shall be pumped into the stack after plugging all inlets and connections at the lowest points from a smoke testing machine which consists of a bellow & burner. The material usually burnt is greasy cotton waste which gives out a clear pungent smoke which is easily detected by sight as well as by smell, if there is leak at any points of the pipe. The top end shall however be left open. The stack shall then be observed for leakiness and all defective pipes and fittings removed or repaired as directed by the Engineer-in-Charge / Owner.

13.3 A test register shall be maintained and all entries shall be signed and dated by Contractor and Engineer-in-Charge/Owner.

14. MEASUREMENTS

14.1 General

a. Rates for all items quoted shall be inclusive of all work and items given in the above mentioned specifications and Schedule of Quantities and applicable for the work under floor, in shafts or at ceiling level at all heights and depths.
b. All rates are inclusive of cutting holes and chases in RCC and masonry work and making good the same.
c. All rates are inclusive of pre testing and on site testing of the installations, materials and commissioning.
14.2 **Pipes** (Unit of measurement. Linear meter to the nearest centimeter)

(a) C.I. (L.A) pipes shall be measured along the center line when fixed, correct to a centimeter including all fittings and lead caulked joints along its length.

(b) C.I. pipes shall be measured overall along the center line correct to a centimeter including all fittings along its length. The rate for these pipes shall be inclusive of all fittings, holder bat clamps, lead caulked joints and all other items described in the Schedule of Quantities. Traps structural clamps and cement concrete shall however be paid separately under the relevant item.

(c) G.I., S.C.I & P.V.C. Polythene pipe shall be measured per running meter correct to a centimeter for the finished work, which shall include fittings e.g. Bends, Tees, Elbows,Reducers, Crosses, Sockets, Nipples and Nuts but exclude brass or Gunmetal Taps (Cocks), Valves lead connection pipes and shower rose. The length shall be taken along center line of the pipes and fittings. All pipes and fittings shall be classified according to their diameter, method of jointing and fixing substance, quality and finish. The diameter shall be nominal diameter of internal bore. The pipes shall be described as including all cutting and waste. In case of fittings of unequal bore, the largest bore shall be measured. All HDPE pipes shall be measured overall along the center line correct to a centimeter including all fittings along its length. The rate for these pipes shall be inclusive of all items as described in the Schedule of Quantities. Traps, fittings, clamps and cement concrete shall be paid separately under the relevant item.

14.3 Cement concrete all round pipes shall be measured along the center of the pipe line measured per linear meter and include any Masonry Supports, Shuttering and Centering Cutting complete as described in the relevant specifications.

14.4 Slotted angles/channels shall be measured per linear metre of finished length and shall include support bolts and nuts embedded in masonry walls with cement concrete blocks and nothing extra will be paid for making good the same.

14.5 **Painting**: Painting of pipes shall be measured per running metre and shall be inclusive of all fittings and clamps. No deduction for fittings shall be made.

14.6 **Structural Clamps**: Structural clamps and U clamps shall be paid for by weight per kg. rates shall be inclusive of all nuts, bolts, dash fasteners, drilling, cutting, welding. Weight of clamps shall be calculated from the actual length used in structural members multiplied by its theoretical weight given in manufacturers catalogues. Weight of nuts, bolts, shall not be taken into account. M.S holder bats for holding C.I pipes in walls shall not be measured separately and it shall be a part of fixing C.I pipes.

14.7 **Excavation for soil pipes**: No extra payment shall be admissible with respect to excavation, refilling and disposal of surplus earth for Cast Iron Soil and Waste Pipes.
E) WATER SUPPLY SYSTEM

1. SCOPE OF WORK
1.1 Work under this section consists of furnishing all labor, materials equipment and appliances necessary and required to completely install the water supply system as required by the drawings, specified hereinafter and given in the Schedule of Quantities.

1.2 Without restricting to the generality of the foregoing, the water supply system shall include the following:-

   a) All water lines to different parts of building and making connection from source etc.
   b) Pipe protection and painting.
   c) Providing Hot water supply lines and insulation of hot water pipe lines.
   d) Control valves, masonry chambers and other appurtenances.
   e) Connections to all toilets, kitchen equipments, storage tanks and appliances.
   f) Excavation and refilling of pipe trenches, wherever required.
   g) Trenches for taking pipe lines for these services.

2. GENERAL REQUIREMENTS
2.1 All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Engineer-in-Charge / Owner.

2.2 Pipes and Fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

2.3 Short or Long bends shall be used on all main pipe lines as far as possible. Use of Elbows shall be restricted for short connections. As far as possible all Bends shall be formed by means of a hydraulic pipe bending machine for pipes up to 65mm dia.

2.4 Pipes shall be fixed in a manner so as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

2.5 Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.

2.6 Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.

3. CPVC PIPES AND FITTINGS

3.1 Description
CPVC piping shall be Fire Proof, Corrosion resistance with smooth, friction free interior surfaces and with anti - bacterial growth properties.

3.2 JOINING TUBING & FITTINGS

(a) Cutting
CPVC tubing shall be cut with a wheel-type plastic tubing cutter, a hack saw or other fine toothed hand or power saws. Use of ratchet cutters shall be permitted, provided blades are sharpened regularly. A milter box should be used to ensure a square cut when using a saw.
(b) **Deburring/Beveling**

Burr and fillings can prevent proper contact between tube and fitting during assembly, and should be removed from the outside and inside of the tubing. A chamfering tool shall be used for this purpose. A slight bevel on the end of the tubing shall be provided to enable entry of the tubing into the fitting socket and minimize the chances of pushing solvent cement to the bottom of the joint.

(c) **Fitting Preparation**

The surfaces shall be wiped clean of dirt and moisture from the fitting sockets and tubing end. Check the dry fit of the tubing and fitting. The tubing should make contact with the socket wall 1/3 to 2/3 of the way into the fitting socket.

(d) **Solvent Cement Application**

Only approved type Solvent Cement shall used for jointing the CPVC pipes, which shall be procured as per the manufacturer recommendations. Apply an even coat of Cement Solvent on the Pipe end after cleaning of whole pipe and also inside the fittings socket. Old or deteriorated or thickened or lumpy Solvent Cement shall not be used.

(e) **Assembly**

Immediately insert the pipe into fitting socket, rotate the pipe ¼ to ½ turn while inserting. This motion ensures an even distribution of cement within the joint. Properly align the fitting. Hold the assembly for approximately 10 seconds, allowing the joint to set-up. An even bead of cement should be evident around the socket edge, it may indicate that sufficient cement was applied. In this case, remake the joint to avoid potential leaks. Wipe excess cement from the tubing and fitting surfaces for an attractive, professional appearance.

(f) **Rating & Dimensional Details of CPVC Pipes SDR 11**

<table>
<thead>
<tr>
<th>Nominal Pipe Size</th>
<th>Average Outside Diameter</th>
<th>Wall Thickness</th>
<th>Pressure Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>inch</td>
<td>Mm</td>
<td>inch</td>
<td>mm</td>
</tr>
<tr>
<td>½</td>
<td>12.70</td>
<td>0.625 (15.9)</td>
<td>0.068 (1.73)</td>
</tr>
<tr>
<td>¾</td>
<td>19.05</td>
<td>0.875 (22.2)</td>
<td>0.080 (2.03)</td>
</tr>
<tr>
<td>1</td>
<td>25.40</td>
<td>1.125 (28.6)</td>
<td>0.102 (2.59)</td>
</tr>
<tr>
<td>1 ¼</td>
<td>31.75</td>
<td>1.375 (34.9)</td>
<td>0.125 (3.18)</td>
</tr>
<tr>
<td>1 ½</td>
<td>38.10</td>
<td>1.625 (41.3)</td>
<td>0.148 (3.76)</td>
</tr>
<tr>
<td>2</td>
<td>50.80</td>
<td>2.215 (54.0)</td>
<td>0.193 (4.90)</td>
</tr>
</tbody>
</table>
4. **G.I. PIPES & FITTINGS**

4.1 All pipes inside the buildings and where specified, outside the building shall be galvanized steel tubes conforming to I.S. 1239-1979 of class specified. When class is not specified they shall be medium class.

4.2 Fittings shall be malleable iron galvanized fittings, of approved make. All fittings shall have manufacturer’s trade mark stamped on it. Fittings for G.I. pipes shall include Couplings, Bends, Tees,Reducers, Nipples, Unions, Bushes, Fittings shall be of I.S:1879 - (part I to X) 1975.

4.3 Pipes and fittings shall be jointed with screwed fittings. Care shall be taken to remove burr from the end of the pipe after cutting by a round file. Genuine red lead with grumet and a few strands of fine hemp shall be applied. All pipes shall be fixed in accordance with layout and alignment shown on the drawings. Care shall be taken to avoid air pockets. G.I. pipes inside toilets shall be fixed in wall chases well above the floor. No pipes shall be run inside a sunken floor as far as possible. Pipes may be run under the ceiling or floors and other as shown on drawings.

5. **CLAMPS**

G.I. pipes in shafts and other locations shall be supported by M.S. clamps of design approved by Engineer-in-Charge / Owner. Pipe in wall chases shall be anchored by iron hooks. Pipes at ceiling level shall be supported on structural clamps fabricated from M.S. structural as described in the sub section. Pipes in typical shafts shall be supported on Slotted Angles/Channels as specified elsewhere.

6. **UNIONS**

Contractor shall provide adequate number of unions on all pipes to enable dismantling later. Unions shall be provided near each Gunmetal Valve, Stop Cocks, or Check Valves and on straight runs as necessary at appropriate locations as required and/or directed by Engineer-in-Charge / Owner.

7. **FLANGES**

Flanged connections shall be provided on pipes where shown on the drawings, all equipment connections as necessary and required or as directed by Engineer-in-Charge / Owner. Connections shall be made by the correct number and size of the bolts and made with 3 mm thick insertion rubber washer. Where hot water or steam connections are made insertion gasket shall be of suitable high temperature grade and quality approved by Engineer-in-Charge / Owner. Bolt hole dia for flanges shall conform to match the specification for C.I. Sluice Valve to I.S. 780.

8. **TRENCHES**

The galvanized iron pipes and fittings shall be laid in trenches. The width and depth of the trenches for the different diameters of the pipes shall be as follows:
<table>
<thead>
<tr>
<th>Dia of Pipe</th>
<th>Width of Trench</th>
<th>Depth of Trench</th>
</tr>
</thead>
<tbody>
<tr>
<td>15mm to 50mm</td>
<td>30 cms</td>
<td>60 cms</td>
</tr>
<tr>
<td>65mm to 100mm</td>
<td>45 cms</td>
<td>75 cms</td>
</tr>
</tbody>
</table>

At joints the trench width shall be widened where necessary. The work of excavation and refilling shall be done true to line and gradient in accordance with general specifications for earthwork in trenches.

When excavation is done in rock, it shall be cut deep enough to permit the pipes to be laid on a cushion of sand minimum 7.5 cm deep.

9. **PAINTING**

9.1 All surfaces shall be thoroughly cleaned before painting.

9.2 All pipes above ground shall be painted with one coat of Red Lead and two coats of Synthetic Enamel paint of approved shade and quality. Pipes shall be painted to standard color code specified by Engineer-in-Charge/Owner.

9.3 All pipes in chases and below floor shall be provided Anti-corrosive treatment.

10. **PIPE PROTECTION**

Where specified in the Schedule of Quantities all pipes below ground shall be protected against corrosion by wrapping 100mm wide and 4mm thick layer of material of approved make over the pipe.

11. **GUNMETAL VALVES**

11.1 Valves 65mm dia and below shall be heavy Gunmetal Fullway Valves or Globe Valves or Ball valves conforming to I.S. 778-1971 of 20 Kg/cm² class. Valves shall be tested at manufacturer’s works and the same stamped on it.

11.2 All Valves shall be approved by the Engineer-in-Charge / Owner before they are allowed to be used on work.

12. **BALL VALVES**

Ball Valves have body material as Forged Brass Chrome plated with Spindle Brass Nickel Plating & Lever handle Steel Chrome plated with green plastic cover. The valve is suitable for water maximum working pressure up to 25 bar (PN 25). The valve is operated by turning. The rotation from open to close is a quarter turn (90°) which closes in a clock-wise direction.

13. **BUTTERFLY VALVES**

a) Butterfly valves of approved quality for pressure rating of 230 P.S.I. with locking arrangement and gearbox with handle operated or gearbox with lid shall be provided or as given in the Bill of Quantities.
b) Butterfly valves shall be of specified quality conforming to IS: 13095 or BS: 5155.
c) Joints for butterfly valves shall be made with suitable tail/socket pieces on the pipe line and flanged joints made with 3mm thick insertion rubber gasket with appropriate number of bolts, nuts and washers.
d) Butterfly valves shall be provided on all branches as shown in the drawings or as specified.

14. **SLUICE VALVES**

14.1 All valves 80mm dia and above shall be C.I. Double Flanged Sluice Valves. Sluice valves shall be Cast Iron double flanged, with rising spindle. Each sluice valve shall be provided with wheel for valves in exposed positions and Cap Top for underground valves. Contractor shall provide suitable operating keys for Sluice Valves with Cap Tops.

14.2 Sluice valves shall be of best quality conforming to I.S: 780-1969 of class specified.

14.3 Sluice valves shall be socketed type or double flanged type conforming to I.S: 780.

(a) Joints for socketed valves shall be lead-caulked joints as specified above.
(b) Joints for double flanged sluice valves shall be made with suitable tail/socket pieces on the pipeline and flanges joints made with 3 mm thick insertion rubber gasket with appropriate number of bolts, nuts and washers.
(c) Sluice valves shall be installed at all branches and as shown on the drawings.

15. **SCOUR VALVES**

Scour valves shall be C.I. sluice valves as specified above. They shall be installed at the lowest level or tail end of the system as shown on drawings and directed by Engineer-in-Charge / Owner.

16. **AIR RELEASE VALVES**

(a) Air release valves shall be single acting type air valves with cast iron body and bronze/gunmetal internal parts and plastic float.
(b) Each air release valve shall be provided with a cast iron isolating sluice valve of specification given above.

17. **INSULATION**

The insulation for hot water pipes shall be done as specified in Bill of Quantities and accordingly following guidelines shall be followed:

17.1 **For Chased Internal Pipes**

Hot water pipes fixed in chase shall be insulated by wrapping 6 mm thick thermal insulation tubings or Ceramic Rope made up of Ceramic fibres laid parallel to each other with stainless steel wire wrapped around for reinforcing the fibre complete as per requirement and finishing it with 6mm rough cement plaster 1:3 mixed with Rapid Hardening Cement.
17.2 For External Piping

External hot water line laid in trenches, exposed in shafts, on terrace and along ceiling level shall be insulated with either thermal tubings of specified thickness or fibre glass wool blankets/mats, as specified in Bill of Quantities. After the insulation, all the pipes shall be protected with either 12mm thick smooth finished cement plaster (two layers of 6 mm thick of mix 1:2 Portland cement and fine sand) or they shall be cladded with 24 SWG aluminum sheet as specified in Bill of Quantities.

17.3 The specifications of the material shall be generally as follows, unless specified:

(a) Fibre glass wool -- Blankets/mats of 50 mm thickness in the density of 24 kg/m³
(b) Elastomeric Flexible Material -- Thermal Insulation tubings of 6mm thickness with density of 60-90 Kg/m3.

17.4 Generally, following procedure shall be adopted:

(a) Cleaning the pipe surface to be insulated to make it free from dust & oil.
(b) Applying a layer of zinc chromate/anti-rust Japanese primer.
(c) Fixing fibre glass wool blankets or mats/Elastomeric Flexible Tubings as specified.
(d) Covering it around with 24 gauge x \frac{1}{4} " wire netting with proper butt joint and tightly wrapped.
(e) Applying two layers of 6 mm thick each cement plaster in the ratio of 1:2 (1 cement: 2 fine sand).
(f) Applying weatherproofing coating of Insulkote OR of approved material over the cement plaster.
(g) For certain places, where exposed insulation is not to be plastered as specified in item (v) and (vi), then aluminum foil sheet of 24 gauge with 50 mm overlapping, fixed with self tapping recessed screwed shall be provided.

18. CAST IRON PIPES

18.1 Pipes for water supply mains where specified shall be cast iron pipes, centrifugally cast spun iron pipes, class LA conforming to I.S. 1536. Quality certificates shall be furnished.

18.2 Fittings and Inspection Chambers

Fittings and chambers shall be provided as required.

18.3 Anchor Block

Suitable anchor blocks shall be provided at all bends and tees to encounter the excessive thrust developed due to water hammer.

18.4 Rubber Joints

Joints between two pipes shall be made by premoulded rubber joints with suitable tackles in a manner recommended & approved by the manufacturer. No joints shall be covered until the lines are Hydraulically tested.
19. VALVE CHAMBERS
19.1 Contractor shall construct chambers for all full way valves, butterfly valves and other type of valves as specified in the Bill of Quantities. These shall be made, in brick masonry in cement mortar 1:4 (1 cement: 4 coarse sand) on cement concrete foundations 150mm thick 1:5:10 mix (1 cement: 5 coarse sand: 10 graded stone aggregate 40mm nominal size) 12 mm thick cement plaster 1:3(1 cement : 3 coarse sand) inside finished with a floating coat of neat cement with 8mm thick M.S surface box with hinged cover and locking arrangement, 150 mm thick reinforcement cement concrete top slab of 1:2:4 (1 cement : 2 coarse sand: 4 graded stone aggregate 20mm nominal size), as specified and shown in drawings, including excavation, back filling rammed complete or as specified in Bill of Quantities.

19.2 Valve chambers shall be constructed as specified in BOQ but generally shall be of following sizes:

<table>
<thead>
<tr>
<th></th>
<th>Length (mm)</th>
<th>Width (mm)</th>
<th>Depth (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>For pipes dia. Up to 80 mm</td>
<td>600</td>
<td>600</td>
<td>1000</td>
</tr>
<tr>
<td>For pipes dia. 80 mm and above</td>
<td>750</td>
<td>750</td>
<td>1000</td>
</tr>
</tbody>
</table>

20. TESTING
20.1 All pipes, fittings and valves shall be tested by hydrostatic pressure of min. 1.5 times, the working pressure and subject to minimum of 7 kg/cm²in any case and with the consent of Engineer-in-Charge / Owner.

Pressure shall be maintained for a period of at least two hours without appreciable drop in the pressure after fixing at site. (+10 %). A test register shall be maintained and all entries shall be signed and dated by Contractor(s) and Engineer.

20.2 In addition to the sectional testing carried out during the construction, Contractor shall test the entire installation after connections to the overhead tanks or pumping system or mains. He shall rectify all leakages, and shall replace all defective materials in the system. Any damage done due to carelessness, open or burst pipes or failure of fittings, to the building, furniture and Fixtures shall be made good during the defects liability period without any extra cost.

20.3 After completion of the water supply system, Contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. Valves which do not effectively operate shall be replaced by new ones at no extra cost and the same shall be tested as above.

21. MEASUREMENT
21.1 Pipes
Pipes shall be measured per linear meter (to the nearest cm) and shall be inclusive of all fittings e.g. couplings, tees, bends, elbows, unions, deduction for valves shall be made, cutting holes chases and making good the same and all items mentioned in the specifications and Schedule of Quantities.
(a) Gunmetal and cast iron valves shall be measured by numbers.
(b) Single flanges shall be measured by numbers (per single flange) and shall include bolts, nuts, washers and 3mm thick rubber gasket complete.
(c) Pair of flanges shall be measured by number of pairs and shall include bolts, nuts, washers, and 3 mm thick rubber gaskets complete.

21.2 Insulation

Insulation for hot water pipes shall be measured per linear metre (to the nearest cm) along the centre line of pipe and shall be measured over all fittings and flanges. No separate or additional payment shall be made for insulation of Bends, Tees, Flanges or Other Fittings and Valves. The rate shall include all items specified in the Schedule of Quantities and given in the specifications.

Aluminum cladding/Plaster over the insulated pipes shall be measured by square metre area of the finished surface. The rate shall be inclusive of all items given in the Schedule of Quantities.

21.3 Painting

Painting for Pipes and over insulation shall be measured per linear metre over finished surface and shall include all valves and fittings for which no deduction shall be made.

22. DISINFECTION

22.1 After completion of the work Contractor shall flush clean the entire system with the city’s filtered water after connection has been made.

22.2 After the first flushing, commercial bleaching powder is to be added to achieve a dosage of 2 to 3 mg/l of water in the system added and flushed. This operation should be performed twice to ensure that the system is fully disinfected and usable.

23. PRE COMMISSIONING

23.1 Ensure that all pipes are free from debris and obstructions.

23.2 Check all valves and fire hydrant for effective opening and closing action. Defects should be rectified or valves replaced.

23.3 Ensure that all Connections to Branches has been made.

23.4 Ensure that mains have been connected to the respective pumps, underground and overhead tanks.

23.5 Water supply should be available at main Underground tank.

23.6 All main line Valves should be closed.

24. COMMISSIONING

24.1 Fill Underground tank with water. Add 1kg fresh bleaching powder after making a solution to be added near inlet.
24.2 Start Water Supply Pump and allow water to fill main Underground tank. Water will first fill the fire tank and then overflow to the Raw Water tanks.

24.3 After filling Overhead Reservoir drain the same to its one forth capacity through tank scour valve. (This is to ensure removal of all mud, debris etc. from the tank).

24.4 Fill Overhead tank to full.

24.5 Release water in the main lines by opening Valves in each circuit. Drain out water in the system through scour valves or fire hydrant in lower regions. Ensure clean water is now coming out of the system.

24.6 Open valves for individual clusters. Observe for leakages or malfunctions, check pressure & flow at end of line by opening Hydrants etc. Remove and rectify defects noticed.

24.7 Check all outlet points for proper operation by opening each valve and allowing water to flow for a few minutes. Also check for effective closure of valve.

24.8 The entire water supply system should be disinfected with bleaching powder and system flush cleaned.

24.9 Send four samples of water drawn from four extreme locations for testing for bacteriological test in sterilized bottles obtained from the concerned laboratory. (Laboratory personal may collect the samples themselves).

25. **RESPONSIBILITY**

Responsibility for various activities in pre-commissioning and commissioning procedures will rest with the Contractor.

**F) SEWERAGE / DRAINAGE SYSTEM**

1. **SCOPE OF WORK**

1.1 Work under this section shall consist of furnishing all Labor, Materials, Equipments and Appliances necessary and required to completely finish Sewerage/Drainage system as required by the drawings and specified hereinafter or given in the Schedule of Quantities.

1.2 Without restricting to the generality of the foregoing, the sewerage system shall include:

- Connection to First Man Hole and Gully Trap & Storm Water chamber.

2. **GENERAL REQUIREMENTS**

2.1 All materials shall be new of the best quality conforming to specifications and subject to the approval of the Engineer-in-Charge / Owner.

2.2 Drainage lines shall be laid to the required gradients and profiles.
2.3 All drainage work shall be done in accordance with the local Municipal byelaws.

2.4 Location of all manholes, catch basins etc., shall be got confirmed by the Contractor from the Engineer-in-Charge / Owner before the actual execution of work at site.

2.5 All works shall be executed as directed by Engineer-in-Charge / Owner.

3. ALIGNMENT AND GRADE

The sewer pipes shall be laid to alignment and gradient shown on the drawings but subject to such modifications as shall be ordered by the Engineer-in-Charge / Owner from time to time to meet the requirements of the works. No deviations from the lines, depths of cutting or gradients of sewers shown on the plans and sections shall be permitted except by the express direction in writing of the Engineer-in-Charge / Owner.

4. SALT GLAZED STONEWARE PIPES

4.1 Pipes and Fittings shall be new and of the best quality, grade and shall confirm to IS: 651. The Glaze shall be free from crazing, fire cracks or hair cracks. There shall be no broken blisters. There shall be sharp clear tone when struck lightly. Pipes shall be with spigot and socket ends.

4.2 Laying and Jointing of Stoneware Salt Glazed Pipes

(a) Pipes are liable to be damaged in transit and notwithstanding tests that may have been made before dispatch each pipe shall be examined carefully on arrival at site. Each pipe shall be rung with a wooden hammer or mallet and those that do not ring true and clear shall be rejected. Sound pipes shall be carefully stacked to prevent damage. All defective pipes should be segregated, marked in a conspicuous manner and their use in the works prevented.

(b) The pipes shall be laid with sockets leading uphill and should rest on solid and even foundations for the full length of the barrel. Socket holes shall be formed in the foundation sufficiently deep to allow the pipe jointer room to work right round the pipe and as short as practicable to admit the socket and allow the joint to be made.

(c) Where pipes are not bedded on concrete the trench bottom shall be left slightly high and carefully bottomed up as pipe laying proceeds so that the pipe barrels rest on firm ground. If excavation has been carried too low it shall be made up with cement concrete 1:5:10 mix at the Contractor’s cost and charges.

(d) If the bottom of the trench consists of rock or very hard ground that cannot be easily excavated to a smooth surface, the pipes shall be laid on cement concrete bed of 1:5:10 mix to ensure even bearing.

4.3 Jointing of Pipes

(a) Tarred gaskin shall first be wrapped round the spigot of each pipe and the spigot shall then be placed into the socket of the pipe previously laid, the pipe shall then be adjusted and fixed in its correct position and the gaskin caulked tightly home so as to fill not more than one quarter of the total length of the socket.

(b) The remainder of the socket shall be filled with stiff mix of cement mortar (1 cement: 1 clear sharp washed sand). When the socket is filled, a fillet should be formed round the
joint with a trowel forming an angle of 45 degrees with the barrel of the pipe. The mortar shall be beaten up and used after it has begun to set.

(c) After the joint has been made any extraneous materials shall be removed from inside of the joint with a suitable scraper or "Badger". The newly made joints shall be protected until set from the sun, drying winds, rain or dust. Sacking or other materials, which can be kept damp, shall be used. The joints shall be exposed and space left all rounds the pipes for inspection by the Engineer-in-Charge / Owner. The inside of the sewer must be kept absolutely clear in bore and free from cement mortar or other obstructions throughout its entire length, and shall efficiently drain and discharge.

5. **GULLY TRAPS**
   5.1 Gully traps shall be of the same quality as described for stoneware pipes in Clause 4.
   5.2 Gully traps shall be fixed in cement concrete 1:5:10 mix (1 cement: 5 coarse sand: 10 stone aggregate 40mm nominal size) and a brick masonry chamber 30x30 cms inside in cement mortar 1:3 with 10 x 10 cms grating inside and 30x30 cms C.I. sealed cover and frame weighting not less than 7.2 kg to be constructed as per standard drawing. Where necessary, sealed cover shall be replaced with C.I. grating of the same size.

6. **GREASE TRAP**
Grease Trap shall be provided on Kitchen waste lines before discharging the waste into the main sewer line. Grease Trap shall be built in brick masonry and shall be similar in construction to manholes. The grease trap shall be construction to size as shown at the location on drawings. The grease trap shall be provided with drop inlet, drop outlet, galvanised wrought iron sediment pan and a baffle wall. Grease trap shall be provided with 2 Nos, double seal manhole cover and frame which shall be identified with lettering ‘Grease trap’.

7. **REINFORCED CEMENT CONCRETEPIPES**
   7.1 All underground storm water drainage pipes and sewer lines where specified (other than those specified cast iron) shall be centrifugally spun RCC pipes of specified class. Pipes shall be true and straight with uniform bore. Throughout cracked, warped pipes shall not be used on the work. All pipes shall be tested by the manufacturer and the Contractor shall produce, when directed a certificate to that effect from the manufacturer.

   7.2 **Laying**
R.C.C. spun pipes shall be paid on cement concrete bed or cradles as specified and shown on the detailed drawings the cradles may be precast and sufficiently cured to prevent cracks and breakage in handling. The invert of the cradles shall be left 12mm below the invert level of the pipe properly placed on the soil to prevent any disturbance. The pipe shall than be placed on the bed concrete or cradles and set for the line and gradient by means of sight rails and bonding rods etc. cradles or concrete bed may be omitted, if directed by the Engineer-in-Charge / Owner.

   7.3 **Jointing**
After setting out the pipes the collars shall be centered over the joint and filled in with tarred gaskin, so that sufficient space is left on either side of the collar to receive the
mortar. The space shall then be filled with cement mortar 1:2 (1 cement: 2 fine sand) and caulked by means of proper tools all joints shall be finished at an angle of 45 degree to the longitudinal axis of the pipe on both side of the collars neatly.

8. **CAST IRON PIPES FOR DRAINAGE**

8.1 All drainage lines passing under building, floors and roads with heavy traffic, in exposed position above ground e.g. service floor and basement ceiling shall be cast iron pipes. Position of such pipes shall generally be shown on the drawings.

8.2 Cast iron pipes shall be centrifugally spun iron pipes conforming to I.S: 1536. Quality certificates shall be furnished.

8.3 **Fittings and Inspection Chambers**

(a) Fittings used for C.I. drainage pipe shall conform to I.S: 1538. Wherever possible junction from branch pipes shall be made by a ‘Y tee’.

(b) Cleanout plugs shall be provided on head of each drain and at location indicated on plans or directed by Engineer-in-Charge / Owner. Cleanout plugs shall be of size matching the full bore of the pipe. Plugs shall be made out with G.I. coupling caulked into the socket of the pipe or fittings. The end shall be provided with a brass screwed plug with suitable key for opening.

8.4 **Laying**

(a) All cast iron pipes and fittings shall be jointed with best quality soft Pig Lead (conforming to IS: 782) which shall be free from impurities. In wet trenches joints shall be made from Lead Wool. Nothing extra will be paid for Lead Wool joints. Depth of pig lead and weight for joints shall be as given in I.S. code.

(b) The spigot of pipe or fittings shall be centered in the adjoining socket by caulking. Sufficient turns of tarred gaskin to leave unfilled the required depth of socket for depth of 45mm when the gaskin has been caulked tightly home. Jointing ring shall be placed round the barrel and against the face of the socket. Molten Pig Lead shall then be poured to fill the remainder of the socket. This shall then be done in one pouring. The lead shall then be solidly caulked with suitable tools and hammers weighting not less than 2 kg.

(c) For lead wool joints the socket shall be caulked with tarred gaskin, as explained above. The lead wool shall be inserted into the sockets and tightly caulked home skein by Gaskin with suitable tools and hammers of not less than 2 kg weight until joint is filled.

8.5 **Testing**

(a) All lengths of the sewer and drain shall be fully tested for water tightness by means of water pressure maintained for not less than 30 minutes. Testing shall be carried out from manhole. All pipes shall be subjected to a test pressure of at least 1.5 meter head of water. The test pressure shall, however, not exceed 1.5 meter head at any point. The pipes shall be plugged preferably with standard design rubber plugs on both ends. The upper end shall, however, be connected to a pipe for filling with water and getting the required head. The tolerance figure of two liters per centimeter of dia per kilometer may be allowed during a period of ten minutes. Subsidence of the test water may be due to one or more of the following causes:
• Absorption by pipes and joints
• Sweating of pipe or joints
• Leakage at joints or from defective pipes

(b) Trapped Air
Allowance shall be made for (i) by adding water until absorption has ceased after which the test proper should commence. Any leakage will be visible and the defective part of the work should be cut out and made good. A slight amount of sweating which is uniform may be overlooked, but excessive sweating from a particular pipe or joint shall be watched for and taken as indicating a defect to be made good.

(c) Sewer and Drain Pipelines shall be tested for straightness by:
- Inserting a smooth ball 12mm less than the internal diameter of the pipe. In the absence of obstructions such as yarn or mortar projecting at the joints the ball should roll down the inventor of the pipe and emerge at the lower end.
- Means of a mirror at one end and a lamp at the other end. If the pipe line is straight the full circle of light will be seen otherwise obstruction of deviation will be apparent.

(d) The Contractor shall give a smoke test to the drains and sewer at his own expense and charges, if directed by the Engineer-in-Charge / Owner.

(e) A test register shall be maintained which shall be signed and dated by Contractor, Engineer-in-Charge / Owner and representative of Architects/ Consultants.

9. CEMENT CONCRETE & MASONRY WORKS FOR MANHOLES & CHAMBERS ETC.

9.1 Materials

(a) Water
Acidity, Alkalinity and percentage of Solids shall be in accordance with IS: 3025. The Ph value shall generally be not less than 6. In general potable water is considered satisfactory for use.

Sea water shall not be used.

Testing shall be done individually for different source points before the start of the work and there after once in every three months.

(b) Aggregate for Concrete
It shall be strong, durable and free from adherent coatings, sea shell, organic impurities, disintegrated pieces.

If dirty, shall be washed with water before actual use. Flaky and elongated piece shall be avoided. It shall confirm to IS: 383 and IS: 2386.
(c) **Sand**

It shall be hard, durable, chemically inert, clean and free from adherent coatings, organic matter etc. and shall not contain any appreciable amount of clay balls or pellets and harmful impurities and shall confirm IS: 2386. It shall not contain more than 8 % of silt as per the field test.

Grading for masonry, plaster and concrete shall be as per IS: 2116, IS: 1542, IS: 383 respectively, Sea sand shall not be used.

Testing for bulkage to be done and allowance be made at the time of use.

(d) **Cement**

The cement used for all the constructional purposes shall be Portland pozzolana cement confirming to I.S. 1489 OR rapid hardening, Portland cement conforming to I.S. 269.

Different types of Cement shall not be mixed together, shall be stacked and stored separately. Cement Bags shall be stacked in a manner to facilitate their removal and use in the order in which they are received.

The site where it is stored shall be dry, leak proof and as far as possible moisture proof.

Necessary precautions to be taken to avoid dampness through floor and walls. Stacking shall not be more than 10 bags high.

(e) **Mild Steel Reinforcement**

The mild steel for the reinforcement bars shall be in the form of round/ twisted/deformed bars conforming to all requirements of I.S. 432 (Grade I).

(f) **Bricks**

Brick shall have uniform color, thoroughly burnt, smooth rectangular faces, with parallel slab, sharp and right angled edges, but not over-burnt.

When struck should give clear ringing sound.

The maximum permissible area of perceptible deposit of efflorescence shall be 50% of the surface area of the Bricks. The affected bricks should not be more than 80% of the lot. There shall be no powdering or flaking of the surface.

The average water absorption shall not exceed 22% by weight after 24 hours immersion in water.

The average minimum compressive strength for bricks of class designation 75 shall not be less than 75 kg / cm².
Other Materials

Other materials not fully specified in these specifications and which may be required in the work shall conform to the latest I.S. All such materials shall be approved by the Engineer-in-Charge / Owner before use.

9.2 Cement Concrete (Plain or Reinforced)

(a) Cement concrete pipes bedding, cradles, foundations and RCC slabs for all works shall be mixed by a Mechanical mixer where quantities of the concrete poured at one time permit. Hand mixing on properly constructed platforms may be allowed for small quantities by the Engineer-in-Charge / Owner. Rate for cement concrete shall be inclusive of all shuttering and centering at all depth and heights.

(b) Concrete work shall be of such thickness and mix as given in the Schedule of Quantities.

(c) All concrete work shall be cured for a period of at least 7 days. Such work shall be kept moist by means of gunny Bags at all times. All pipe trenches and foundations shall be kept dry during the curing period.

9.3 Masonry Work

Masonry work for manholes, chambers, brick masonry pipe trench and such other works as required shall be constructed from 1st class bricks as specified in the Schedule of Quantities in cement mortar 1:4 mix (1 cement: 4 coarse sand). All joints shall be properly raked to receive plaster.

9.4 Cement Concrete for Pipe Support

(a) Wherever specified or shown on the drawings, all pipes shall be supported in concrete bed all round or in haunches. The thickness and mix of the concrete shall be given in the Schedule of Quantities. Type of the bedding is as described as follows:

(b) Unless otherwise directed by the Engineer-in-Charge / Owner cement concrete for bed, all round or in haunches shall be laid as follows:-

<table>
<thead>
<tr>
<th>Description</th>
<th>Upto 3 M depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipes in open ground (No sub soil water)</td>
<td>All round (1:4:8)</td>
</tr>
<tr>
<td>Pipes (all) in sub soil water condition</td>
<td>All round (1:3:6)</td>
</tr>
<tr>
<td>Pipes under the building or at road crossing or under public places</td>
<td>All round (1:2:4)</td>
</tr>
</tbody>
</table>

(1=1 cement, 2-4=coarse sand, 4-8 stone aggregate 20 / 40mm nominal size)

(c) R.C.C. pipes or C.I. pipes may be supported on brick masonry or precast R.C.C or Cast insitu cradles. Cradles shall be as shown on the drawings.
(d) Pipes in loose soil or above ground shall be supported on brick or RCC anchor blocks as shown on the drawings.

10. MANHOLES AND CHAMBERS

10.1 All manholes, chambers and other such works as specified shall be constructed in brick masonry in cement mortar 1:4 (1 cement: 4 coarse sand) or as specified in the Schedule of Quantities.

10.2 All Manholes, Chambers, etc., shall be supported on base of cement concrete of such thickness and mix as given in the Schedule of Quantities or shown on the drawings.

Where not specified, Manholes may be constructed as follows:-

(All dimensions internal clear in cms) (As / BMC Regulation)

<table>
<thead>
<tr>
<th>Size of Manhole Type</th>
<th>90x80 Rect.</th>
<th>120x90 Rect.</th>
<th>91 dia Circular</th>
<th>122 dia Circular</th>
<th>140 dia Circular</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum depth</td>
<td>120</td>
<td>245</td>
<td>170</td>
<td>245</td>
<td>Any depth beyond 245</td>
</tr>
<tr>
<td>Average thickness of R.C.C slab</td>
<td>15</td>
<td>15</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Size of cover and frame (Internal dia)</td>
<td>61x45.5</td>
<td>56 dia</td>
<td>56 dia</td>
<td>56 dia</td>
<td>56 dia</td>
</tr>
<tr>
<td>Weight of cover and frame not less than</td>
<td>38 Kg. or as specified in BOQ</td>
<td>116 Kg. or 170 Kg. or 208 Kg. or as specified in BOQ</td>
<td>116 Kg. or 170 Kg. or 208 Kg. or as specified in BOQ</td>
<td>116 Kg. or 170 Kg. or 208 Kg. or as specified in BOQ</td>
<td>116 Kg. or 170 Kg. or 208 Kg. or as specified in BOQ</td>
</tr>
<tr>
<td>Type of Cover &amp; Frame</td>
<td>C.I</td>
<td>C.I. or SFRC as specified in BOQ</td>
<td>C.I. or SFRC as specified in BOQ</td>
<td>C.I. or SFRC as specified in BOQ</td>
<td>C.I. or SFRC as specified in BOQ</td>
</tr>
</tbody>
</table>

10.3 All manholes shall be provided with cement concrete benching in 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20mm nominal size). The benching shall have a slope of 10cm towards the channel. The depth of the channel shall be full diameter of the pipe. Benching shall be finished with a floating cost of neat cement.
10.4 All manholes shall be plastered with 12/15mm thick cement mortar 1:3 (1 cement: 3 coarse sand) and finished with a floating coat of neat cement inside. Manhole shall be plastered outside as above but with rough plaster.

10.5 All manholes with depths greater than 1 M. shall be provided with plastic encapsulated 20mm square or 25mm round rods foot rungs set in cement concrete blocks 25 x 10 x 10cms in 1:2:4 mix 30cms vertically and staggered. Foot rests shall be coated with coal tar before embedding.

10.6 All manholes shall be provided with cast iron covers and frames and embedded in reinforced cement concrete slab or SFRC precast concrete covers as per instructions of the Engineer-in-Charge / Owner. Weight of cover, frame and thickness of slab shall be as specified in the Schedule of Quantities or as given above.

10.7 All catch basins shall be having C.I. grating or SFRC precast Gully Grating as per instructions of Engineer-in-Charge / Owner. The grating along with frame shall be of approved design and quality as per instruction of Engineer-in-Charge/ Owner.

11. MAKING CONNECTIONS
Contractor shall connect the new sewer line to the existing manhole by cutting the walls, benching and restoring them to the original condition. A new channel shall be cut in the benching of the existing manhole for the new connection. Contractor shall remove all sewage and water if encountered in making the connection without additional cost.

12. MEASUREMENT

12.1 Stoneware Pipes/R.C.C. Pipes/C.I. Pipes
Stoneware pipes/R.C.C. pipes/C.I. pipes shall be measured for the finished length of the pipe line per linear meter i.e. (a) lengths between Manholes shall be recorded from inside of one manhole to inside of other manhole, (b) length between socket of pipe near gully trap and inside of manhole. Rate shall include all items given in the Schedule of Quantities and specifications.

12.2 Gully Traps
Gully traps shall be measured by the number and rate shall include all Excavation, Foundation, Concrete Brick Masonry, Cement Plaster inside and outside, C.I. Grating and sealed cover and frame.

12.3 Manholes
(a) All manholes shall be measured by numbers and shall include all items specified above and necessary Excavation, Refilling & Disposal of surplus earth.

(b) Manholes with depths greater than specified under the main item shall be paid for under “extra depth” and shall include all items as given for manholes. Measurement shall be done to the nearest cm. Depth of the manholes shall be measured from top of the manhole cover to bottom of Channel.
12.4 **Drop Connections**

Drop connections shall be measured by number for a depth of 60 cms or part thereof between invert levels. Additional depth shall be paid for as extra per meter depth as per the actual length of the drop connection, measured to the nearest cm.

12.5 **Making Connections**

Item for making connection to municipal sewer shall be paid for by number and shall include all items given in the Schedule of Quantities and Specifications.

12.6 **Masonry Drains**

Payment for masonry drains shall be made under individual items of Masonry, Cement concrete and plaster by volume or area as given in the Schedule of Quantities.

12.7 **Brick Masonry and Cement Concrete**

Brick Masonry and Cement Concrete shall be measured per cubic metre and shall include all items as given in the Schedule of Quantities.

12.8 **For Cement Plaster**

Length and breadth shall be measured correct to a Centimeter and its area shall be calculated in Sq. M. correct to two places of decimal.

13. **COMMISSIONING**

13.1 After successful testing of the different sewerage and drainage pipes in parts, the Contractor shall provide all facilities including necessary pipings, labours, tools and equipments etc. for carrying out testing and commissioning of the entire external sewerage and drainage system complete as per requirement in the presence of Client representative/Consultant, whenever and as may be required. Generally, the following test/inspection has to be carried out:-

(a) For any Leakages/seepages in the external sewerage and drainage pipes.

(b) For checking the functioning of the entire external sewerage and drainage system including rainwater harvesting system and to ensure that the waste water is continuously flowing towards outfall without any intermediate stagnation.

(c) For the functioning of the valves and accessories etc. by putting ON/OFF the controlling valves of the various diversions in the sewerage and drainage and rain water harvesting system.

G) **MISCELLANEOUS (WATER SUPPLY PUMPS & EQUIPMENTS AND WATER TREATMENT UNIT AND SOLAR HOT WATER GENERATION SYSTEM & DRINKING WATER R.O. TREATMENT SYSTEM**

1. **PUMPS AND WATER TREATMENT EQUIPMENT**

1.1 Work under this sub-head consists of furnishing all labour, materials, equipment and accessories necessary and required to completely install pumping system for various water supply services and water treatment as per drawings, specified hereinafter and given in the Bill of Quantities.

1.2 Without restricting to the generality of the foregoing, the work of pumps and water treatment equipment shall include the followings:

Tech. Specification - 66
(a) Raw water pumps.
(b) Relift pumps for Domestic water
(c) Hydro pneumatic Domestic water pumps
(d) Hydro pneumatic Booster system for Top floors at Terrace level.
(e) Sump pumps for disposal of sewage and drainage.
(f) Water treatment unit consisting of filter, softener and chlorination etc.
(g) Motor control panels, power and control cabling and allied electrical works.
(h) Pipes, valves, accessories, hangers, supports, delivery and suction feeders and connection to proposed pipe work.

2. **PUMP SET**

2.1 **Water Supply Pumps**

(These specifications are applicable for all clear water pumps and as specified in Bill of Quantities)

(a) Water supply pumps shall be suitable for clean water. Pumps shall be single or multistage, monoblock horizontal, vertical, centrifugal pumps with cast iron/stainless steel body and stainless steel/bronze impeller, stainless steel shaft and coupled to a TEFC electric motor by means of a flexible coupling or as specified in bill of quantities. Each pump should operate a curve 10m below specified head.

(b) Pump and motor shall be mounted on a common M.S. structural or C.I. base plate or as required as per site conditions.

(c) Each pump shall be provided with a totally enclosed fan cooled induction motor of required H.P. and RPM specified in the bill of quantities and as per requirement.

(d) Each pumping set shall be provided with a 150mm dia or of suitable size gunmetal "Bourden" type pressure gauge with gunmetal isolation cock and connecting piping.

(e) Provide vibration-eliminating pads appropriate for each pump.

(f) Provide rate of flow measuring meter with bypass arrangement with every set of pumps as shown on the drawings and given in the bill of quantities (to be paid separately).

(g) All water supply pumps shall be provided with mechanical seals, of required specifications.

3. **SUMP PUMP**

3.1 Sump pumps shall be submersible type for lifting domestic sewage or muddy water/drainage as specified in Bill of Quantities. Pump with impeller of approved material shall be mounted on waterproof motor. The impeller shall be suitable for handling solids up to 28-100mm dia. or as specified in Bill of Quantities.

3.2 The pump shall automatically operate with high water level and stop at low water level in the sump by means of “Electronic Level Controller”, of the approved make.
3.3 The sump pumps shall be complete in all respect and shall be installed as per manufacturer's requirement as shown in the drawing. All accessories shall be In-Built as per manufacturer's specification.

4. CABLES
4.1 Contractor shall provide all power control cables from the motor control center to various motors, level controllers and other control devices.

4.2 Cables shall conform to I.S: 1554 and carry ISI mark.

4.3 Wiring cables shall conform to I.S 694.

4.4 All power and wiring cables shall be aluminum conductor PVC insulated armored and PVC sheathed of 1100 volts grade.

4.5 All control cables shall be copper conductor PVC insulated armored and PVC sheathed 1100 Volt grade.

4.6 All cables shall have stranded conductors. The cables shall be in drums as far as possible and bear manufacturer's name.

4.7 All cable joints shall be made in approved manner as per standard practice.

5. CABLE TRAYS
5.1 Contractor shall provide M.S / G.I. slotted cable trays at locations as shown on the drawings and of sizes as given in the bill of quantities.

5.2 Cable trays shall be supported from the bottom of the slab at intervals of 60cms at both ends by anchor fasteners. Cost of MS angle, rods and anchor fasteners etc. shall be included in the rate of the tray and no separate payment shall be made on this account.

5.3 Cost of clips, bolts, nuts, support rods and any other materials required to fix the trays in proper manner shall be included in the rate for trays.

6. EARTHING
6.1 There shall be an independent earthing station. The earthing shall consist of an earth tape connected to an independent plate made of copper or G.I. having a conductivity of not less than 100% international standard. All electrical apparatus, cable boxes and sheath/armor clamps shall be connected to the main bar by means of branch earth connections of appropriate size. All joints in the main bar and between main bar and branch bars shall have the lapping surface properly tinned to prevent oxidation. The joints shall be riveted and sweated.

6.2 Earth plates shall be buried in a pit of 1.20x1.20M at minimum depth of 3M below ground. The connections between main bar shall be made by means of three 10mm brass studs and fixed at 100mm centres. The pit shall be filled with coke breeze, rock salt and loose soil. A G.I. pipe of 20mm dia with perforations on the periphery shall be placed vertically over the plate to reach ground level for watering.
6.3 A brick masonry manhole 30x30x30cm size shall be provided to surround the pipe for inspection. A bolted removable link connecting main bar outside the pit portion leading to the plates shall be accommodated in this manhole for testing.

7. **CONTROL PANELS / STARTERS**

7.1 Switch board cubicles of approved type shall be fabricated from 16-gauge M.S. sheet with dust and vermin proof construction. It shall be painted with powder-coated finish of approved make and shade. It shall be fitted with suitable etched plastic identification plates for each motor. The cubicle shall comprise of the following (Switch gear as given in the bill of quantities):

(a) Incoming main isolation MCCB of required capacity.
(b) Fully Aluminum taped Bus Bar of required capacity.
(c) Isolation MCCB one for each motor.
(d) Fully automatic as specified D.O.L/Star Delta starters suitable for motor H.P. with push buttons one for each motor and on/off/Trip indicating neon lamps. (DOL up to 7.5 HP and Star Delta from more than 7.5 H.P)
(e) Single phase preventor of appropriate rating for each motor.
(f) Panel type ampere meters one for each motor with selector switch.
(g) Panel type voltmeter on incoming main with rotary selector switch to read voltage between phase to neutral and phase-to-phase.
(h) Neon phase indicating lamps for incoming main and on/off/Trip indicating lamps for each motor.
(i) Rotary switch for manual or auto operation for each pump (manual/auto off).
(j) Fully taped separate aluminum bus bars of required capacity and with required outlets.
(k) Space for liquid level controllers as specified + 1 extra space.
(l) The panel shall be pre-wired with colour-coded wiring. All interconnecting wiring from incoming main to switch gear, meters and accessories within the switchboard panel.
(m) Provision of main incoming cables from the top or bottom of the panel.

7.2 All switch gears and accessories shall be of approved make such as “Siemens, English Electric, Larsen & Toubro” or equivalent, or as specified.

7.3 Switchboard cubicles shall be floor or wall mounted type as recommended by manufacturers. All floor-mounted switchboard shall rest on minimum 225mm high platform. The contractor shall provide the shop drawings for base and panels.

8. **VIBRATION ELIMINATORS / FLEXIBLE CONNECTORS**

Provide on all suction and delivery lines double flanged reinforced neoprene flexible pipe connectors. Connectors should be suitable for a working pressure of each pump. Length of the connector shall be as per manufacturer’s details.

9. **ILLUMINATED FACSIMILE ANNUNCIATOR PANEL**

9.1 Scope

9.1.1 Scope of this section comprises the supply, installation, testing and commissioning of illuminated facsimile annunciation panel.

9.2 Illuminated Facsimile Annunciater:
(a) Illuminated facsimile Anunciator shall be provided with facsimile of the building, constructed of acrylic panels of suitable dimensions, showing the Basement, Ground floor plans and section showing the location of Zonal Panels on each typical floor, entry points, various facilities shown with enamels in various colors.

(b) Alarm lights to indicate fire location shall be arranged within the acrylic panel and shall be either automatically lighted by operation of any automatic fire detection devices or manual station, or by control of push button incorporated in the control desk.

(c) Indicator of each building or facility shall include two lamps connected in parallel and so arranged that the failure of either of the lamps is readily apparent when a call or test is made.

(d) Power for the annunciator shall be supplied from the power supply for the control desk.

(e) Representation of the various plans/Drawings on the acrylic of the annunciator shall be by negative film processing with colored Discrimination of various zones for which the drawings shall be furnished for approval.

10. WATER FILTER

10.1 Water filter shall be of dual filter media pressure filter downward or upward flow type suitable for a rate of filtration given in bill of quantities.

10.2 Filter shall be vertical type of required diameter. The shell shall be fabricated from M.S. plate suitable to withstand a working pressure given in bill of quantities. The minimum thickness of shell will be 8mm and dished ends shall be 10mm. The filter shall have at least one pressure tight manhole cover or as specified in Bill of Quantities.

Filter shall be provided with screwed or flanged connections for inlet, outlet, individual drain connections and all other connections necessary and required. Filter shall be painted inside with two or more coats of non-toxic corrosion resistant paint, one coat of red oxide primer outside with two or more coats of synthetic enamel paint of approved shade.

10.3 Under Drain System

Filter shall be provided with an efficient under drain system comprising of collecting pipes, gunmetal/polypropylene nozzles of manufacturer’s design. The entire under drain system be provided on M.S. plate or cement concrete supports.

10.4 Face Piping

Filter shall be provided with interconnecting face piping comprising of inlet, outlet, and backwash pipe complete with pipes, valves and accessories, as per requirement. Piping shall be G.I/M.S. piping, medium duty, as per I.S: 1239 and valves shall be cast iron double flanged sluice valves on SOUNDERS pattern with C.I. body and Neoprene rubber diaphragm (Suggested make LABLINE, AIP or equivalent).

10.5 Accessories

Each filter shall be provided with following accessories:-

(a) Air release valve with connecting piping.
(b) 150mm dia dial bourden type gunmetal pressure gauges with gunmetal isolation cock and connecting piping on inlet and outlet.
(c) Sampling cocks on raw water inlet and filtered water outlet.
(d) Individual drain connection with gunmetal fullway valve.
(e) Connection with valve for air scouring.

11. **PIPING**

11.1 Pipes for suction and delivery shall be galvanized/M.S tube (heavy duty) confirming to I.S:1239 upto 150mm dia and as per I.S:3589 for dia 200mm and above or as specified in bill of quantities. The M.S. flanges shall confirm to I.S:6392-1971.

11.2 Gate valve and check valve above 65mm dia shall be C.I. double flanged conforming to I.S:780 manufactured by the reputed manufacturers or C.I. double flanged butterfly valves as specified in bill of quantities or elsewhere or as per approval of Engineer-in-charge.

11.3 Full way and check valves 65mm dia and below shall be gunmetal tested to 20Kg/cm² pressure certified and conforming to I.S:778.

11.4 Suction strainer or foot valves shall be C.I., confirming to I.S:4038 - 1979, as specified in bill of quantities.

11.5 **STAINLESS STEEL PIPES (GRADE SS304)**

Stainless steel pipes and fittings shall conform to JIS 3448 standard complete with press type fittings for Hot and cold water supply, RO & domestic water supply system capable to withstand temperature upto 1300 centigrade and pressure upto 10-12 bars made from 304 (1.4301) grade of annealed and pickled stainless steel sheet, with ends deburred at 900 and with length of 3 meters. Pipe qualifying to 100% eddy current, 100% hydrostatic tested and air-under water tested under 10kgs. Fittings conforming to JWWA G116 standard in 304 grade stainless steel such as tees, coupling, elbow, male adapter, connectors etc with O-ring of EPDM material which can withstand temperature upto -200 to 1100 C of approved make including suitable connection as per site requirement.

11.6 **Joints**

All pipes and fittings shall be provided with flanged joints, with flanges either screwed or welded complete and jointed with 1.5mm thick gasket complete with nuts, bolts and washers etc.

Direct contact of stainless steel pipes and fittings to galvanized iron should be avoided by inserting approved type of filler material as per project manager's/consultant requirement

11.7 **Testing**

All G.I/M.S pipes shall be tested hydrostically for a period of 30 minutes to 1.5 time of working pressure, without drop in pressure.
12. **MEASUREMENTS**

12.1 Raw water and garden pump and shall be measured by numbers and hydro pumps and sump pumps shall be measured by sets and shall include all items as given in the bill of quantities.

12.2 Motor control panel and level controllers shall be measured by numbers.

12.3 Pipes for suction and delivery header and mains shall be measured per linear meter along the centre line of the pipe and shall be inclusive of all fittings.

12.4 Cable trays and cables shall be measured per linear meter.

12.5 Structural clamps including hangers shall be measured by weight calculated from sections used. No separate payment shall be admissible for bolts, anchor bolts, raw plugs etc.

12.6 No separate payment shall be made for making connections of the existing service lines to the pumps. Vibration eliminator pads are included in the scope of this work.

13. **GUARANTEE**

13.1 The contractor shall submit a warranty for all equipment, materials and accessories supplied by him against manufacturing defects, malfunctioning or under capacity functioning.

13.2 The form of warranty shall be as approved by the Engineer-in-charge.

13.3 The warranty shall be valid for a period of one year from the date of commissioning and handing over.

13.4 The warranty shall expressly include replacement of all defective or under capacity equipment, Engineer-in-charge may allow repair of certain equipment if the same is found to meet the requirement for efficient functioning of the system.

13.5 The warranty shall include replacement of any equipment found to have capacity lesser than the rated capacity as accepted in the contract. The replacement equipment shall be approved by the Engineer-in-charge.

14.1 **SOLAR HOT WATER GENERATION SYSTEM**

The Solar Hot Water generation system shall be consisting of the specifications as per the guidelines given below and as mentioned in the BOQ.

14.2 **PIPING**

14.2.1 Pipes for suction and delivery shall be galvanized confirming to IS: 1239 up to 150mm dia and as per I.S:3589 for dia 200mm and above or as specified in Bill of Quantities. The M.S./G.I flanges shall conform to I.S:6392-1971.

14.2.2 Gate valve and check valve above 65mm dia shall be C.I. double flanged conforming to I.S:780 manufactured by KIRLOSKAR, BURN, KILBURN, LEADER or C.I. double flanged Butterfly Valves as specified in Bill of Quantities or elsewhere.
14.2.3 Ball Valve and Check valves 65mm dia and below shall be gunmetal tested to 20Kg/Sq.cm pressure certified and conforming to I.S:778.

14.2.4 Suction Strainer or Foot Valves shall be C.I., confirming to I.S:4308 - 1979, as specified in Bill of Quantities.

14.3 Joints

All pipes and fittings shall be provided with screwed joints upto 65mm dia and flanged joint above 65mm dia, with flanges screwed complete and jointed with 3.0mm thick gasket complete with nuts, bolts and washers etc.

14.4 Testing

All G.I. pipes of Primary Circuit (Collector Circuits) shall be tested to hydrostically for a period of 30 minutes to a pressure of 2 Kg/Sq.cm without drop in pressure and all other G.I pipes for a pressure of 6 Kg/Sq.cm.

14.5 MEASUREMENTS

(a) Pipes for suction and delivery header and mains shall be measured per linear meter along the centre line of the pipe and shall be inclusive of all fittings.

(b) Solar flat plate collector consists of the following components shall be measured as detailed below:-

- Toughened /Tempered Glass cover plate/Glazing material
- Collector box
- Absorber
- Stand

14.6 COVER PLATE

The cover plate shall be tempered/toughened glass as per I.S: 2553 (Part-I) 1990 in single piece of 4.0mm thick with solar transmittance of 85% (minimum) at near normal incidence. The glass shall be free from bubbles and rough surface and shall satisfy “Thermal Shock Test”, “Impact test” and “Transmittance Test”.

14.7 COLLECTOR BOX

14.7.1 The collector box shall be made of aluminum as per I.S: 737 (Latest). The thickness should not be less than as specified herein after.

(a) For Sides -- Channel section of 100mmx25mmx1.6mm

(b) For bottom -- Sheet of thickness 0.71mm

(c) For cover plate sheet -- Angle section 25mmx25mmx1.2mm

(d) For Body -- Sheet thickness 1.0mm

(e) Collector Size -- 1860mm x 1240mm x 100mm

(f) Absorber Area of One Collector -- 2.1 Sq.m
14.8 All surfaces shall be smooth & free from roughness, raised sports, scale or any other surface defects. Sharp edges and corners shall be rounded off.

14.9 The collector box, the side channels are welded at the corner by inert arc welding or gas brazing. Bottom sheet shall be joined spot welding and any suitable method to give proper joint. The joints shall be made leak proof by suitable sealing compound.

14.10 Collector box shall be insulated with material to achieve heat resistance of 0.8m2 °C/W. The minimum thickness should not be less than 50mm.

14.11 Aluminum foil of thickness 0.012mm (min.) shall be used for covering the back as well as side insulation.

14.12 Back and side insulation shall withstand at 175 °C.

14.13 Gaskets & Grommets to be used for sealing the glass with collector box and header joints with collection box should be of such material, so that no dust can pass through the joint and shall be capable of withstanding upto 125 °C and shall conform to the standard Thermal Shock Test.

14.14 The heat resistance shall be determined as per latest edition of I.S:3346.

14.15 ABSORBER

(a) The absorber shall be of copper sheet as per I.S: code 1550 (latest) Min. 0.15mm minimum thickness. The risers and header pipes shall be of Copper. The welding between Copper tube riser and Copper Sheet should be Laser -Welding.

(b) The sheet shall be coated with selective coating to satisfy solar absorbility of more than 0.96 & emissivity < 0.12.

(c) The selective coating shall not damage when the sample is raised to 200 °C temperature.

(d) All tests such as solar absorbility test, emissivity test and temperature tests are to be carried out as per standard tests.

14.16 STAND

The stand for the collector and hot water storage tank are to be designed taking into consideration the load to be carried by the stand. The collector becomes vulnerable to wind dust. The collector may be up-listed by wind striking the underside. This wind load should be determined according to accepted engineering practices and procedures and the stands is to be designed taking into consideration the worst condition of loading.

14.17 HOT WATER STORAGE TANK & HEAT EXCHANGER

Hot water storage tank shall be fabricated from SS:304.

(a) Stainless Steel:316 plate type Heat Exchanger of suitable area shall be provided between Primary and Secondary circuits to prevent scale formation inside the tubes of Absorber of Collector and to transfer required heat energy from Primary to Secondary circuit.

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(b) Inlet connection of cold water supply line of required size (dedicated for solar) to be provided into the hot water tank.

15.0 SHOP DRAWINGS & SPECIFICATIONS

15.1 The Contractor shall submit to the Consultant two copies of Shop Drawings for Plumbing works as an Advance Copy to the Engineer-in-Charge for approval before start of work. Subsequent to the approval of the shop drawings, the Contractor shall submit six copies of Shop Drawings for execution to the Engineer-in-Charge. Also the Contractor shall submit four copies of the Technical Specifications and Catalogues.

15.2 Shop drawings shall be submitted for the following conditions:

(a) Structural supports/hanging/laying and jointing details for all types of pipes as required.

(b) All plans as required and for any changes in the proposed schematic.

15.3 The Contractor can only commence the work after the approval of above documents by Consultant.

H) SOLAR HOT WATER GENERATION SYSTEM

1.1 SOLAR HOT WATER GENERATION SYSTEM

The Solar Hot Water generation system shall be consisting of the specifications as per the guidelines given below and as mentioned in the BOQ

1.2 PIPING

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1.2.2 Gate valve and check valve above 65mm dia shall be C.I. double flanged conforming to I.S:780 manufactured by KIRLOSKAR, BURN, KILBURN, LEADER or C.I. double flanged Butterfly Valves as specified in Bill of Quantities or elsewhere.

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1.5 **MEASUREMENTS**

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(b) Solar flat plate collector consists of the following components shall be measured as detailed below:-

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(e) Collector Size -- 1860mm x 1240mm x 100mm

(f) Absorber Area of One Collector -- 2.1 Sq.m

1.8 All surfaces shall be smooth & free from roughness, raised sports, scale or any other surface defects. Sharp edges and corners shall be rounded off.

1.9 The collector box, the side channels are welded at the corner by inert arc welding or gas brazing. Bottom sheet shall be joined spot welding and any suitable method to give proper joint. The joints shall be made leak proof by suitable sealing compound.

1.10 Collector box shall be insulated with material to achieve heat resistance of 0.8m2 °C/W. The minimum thickness should not be less than 50mm.

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1.2 Shop drawings shall be submitted for the following conditions:

(a) Structural supports/hanging/laying and jointing details for all types of pipes as required.

(b) All plans as required and for any changes in the proposed schematic.

1.3 The Contractor can only commence the work after the approval of above documents by Consultant.
TECHNICAL SPECIFICATIONS FOR PHE WORKS

A) SCOPE OF WORK

1.1 Work under this contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely furnish all the Plumbing and other specialized services as described hereinafter and as specified in the Schedule of Quantities and/or shown on the Public health engineering Drawings.

This contract is an Item Rate Contract. All payments are made for the actual work executed. Any variation in the quantities will not have any extra cost implication on the quoted rates.

1.2 Without restricting to the generally of the foregoing installations shall include the following:

a) Excavation For Pipeline

b) External Sewerage System
   • Collection of Sewage from each unit
   • Conveyance System including pipeline connection to chambers & manholes
   • Connection to STP

c) External Drainage System
   • Collection of run-off from each unit
   • Conveyance of drainage from each unit excluding RCC Culverts
   • Construction of collection chambers & manholes
   • Rainwater Harvesting including rechargeable wells
   • Final disposal to water bodies

d) External Water Supply System
   • Domestic Water Main Distribution System from plant room to various units of entire campus.
   • Tubewell Rising Main to Plant Room
   • Flushing Water Distribution System from STP to various units in the entire campus.
   • External Garden Hydrant System including Garden Hydrant points in connection from treated effluent from STP & rainwater from water bodies.
   • Construction of control valves, masonry chambers & all other appurtenances.
   • External Hydrants on water distribution as required.

e) Water Supply Pumps, Mechanical & Electrical Equipments & Water Treatment Units
   • Raw Water Pumps
   • Treatment Units
   • Re-lift Pumps & Equipments & all other related accessories
1.3 Services rendered under sub-section 1.4 shall be done without any extra charge.

1.4 The Contractor must get acquainted with the proposed site for the works and study Specifications and Conditions carefully before tendering. The work shall be executed as per programme approved by the Engineer-In-Charge / Owner. If part of site is not available for any reason or there is some unavoidable delay in supply of materials stipulated by the Owner, the programme of construction shall be modified accordingly and the Contractor shall have no claim for any extras or compensation on this account.

1.5 Works area shall be the area shown in the plan.

**B) TECHNICAL CONDITIONS**

1. **LICENSE AND PERMITS**

1.1 Contractor must hold a valid Plumbing license issued by the Municipal Authority or other competent authority under whose jurisdiction the work falls.

1.2 Contractor must keep constant liaison with all relevant authorities and shall be responsible for obtaining all approvals relating to water supply, sewerage, storm-water drainage system including rainwater harvesting complete.

1.3 Contractor shall obtain No Objection Certificate before commencement of work, from the local authorities all related to his work as required for the building.

1.4 Contractor shall obtain, from the local authorities all related completion certificates with respect to his work as required for occupation of the building.

1.5 No additional charges other than official payment shall be payable to the contractor on getting NOC / completion certificate/Inspection fees. Unless it is obtained, the final payment of the contractor shall not be released.

2. **METRIC CONVERSION**

2.1 All dimensions and sizes of materials and equipment given in the tender document are commercial metric sizes.

2.2 Any weights, or sizes given in the tender having changed due to metric conversion, the nearest equivalent sizes accepted by Indian Standards shall be acceptable without any additional cost.

3. **REFERENCE POINTS**

3.1 Contractor shall provide permanent Bench Marks, Flag Tops and other reference points for the proper execution of work and these shall be preserved till the end of the work.

3.2 All such reference points shall be in relation to the levels and locations given in the Architectural and Plumbing drawings.
4. **GENERAL INSTRUCTIONS**

4.1 All works specified in the tender have to be executed in accordance with:

   a) The rules and regulations of Local Authority Having Jurisdiction, and as per the statutory regulations applicable.

   b) Applicable norms laid down by the relevant sections of latest editions of National Building Code (NBC) and all relevant codes of Bureau of Indian Standards (B.I.S.) shall be followed as applicable.

   c) The codes of the Uniform Plumbing Code of India and relevant British Standards shall be used as a general guide for good engineering practice, design and workmanship norms.

4.2 All materials used in the works shall have Bureau of Indian Standards valid certification stamped, marked or cast on the material in an acceptable and approved manner, as specified hereinafter.

4.3 It is the contractor's responsibility to ensure the competence of design to meet the above requirements.

4.4 Drawings issued with the tenders are schematic and indicate the concept. Contractor shall make his shop drawings on basis of Architectural and Interior design drawings issued by the Engineer-in-Charge. Work will be executed only as per approved shop drawings.

4.5 Quantities in the tender document are approximate worked out on the tender drawing issued.

4.6 Contractors are invited to highlight any aspects of the contract document that may need revision or reconsideration before the work is started. He must furnish details of any variations in the specifications or the quantities that may be necessary for him to comply with the Code and statutory requirements. These may be identified and approval of the Project managers taken before the start of the work.

4.7 Contractors shall furnish detailed Shop drawings, hydraulic and other design calculations for approval.

4.8 Work under this contract shall be carried out strictly in accordance with Specifications attached with the tender.

4.9 Items not covered under these Specifications due to any ambiguity or misprints, or additional works, the work shall be carried out as per Specifications of the latest Central Public Works Department with latest amendments as applicable in the contract.

4.10 The work shall be carried out strictly as specified in Schedule of Quantities and Technical Specifications. In case of any ambiguity, the details of particular item as given in Schedule of Quantities shall supersede the details in Specifications.
5. **DRAWINGS ISSUED TO CONTRACTOR**

5.1 Plumbing drawings are diagrammatic but shall be followed as closely as actual construction permits. Any deviations made shall be in conformity with the Architectural and other services drawings.

5.2 Architectural drawings shall take precedence over Plumbing or other services drawings as to all dimensions.

5.3 Contractor shall verify all dimensions at site and bring to the notice of the Architects, all discrepancies or deviations noticed. Architects decision shall be final.

5.4 Large size details and manufacturers dimensions for materials to be incorporated shall take precedence over small-scale drawings.

5.5 All drawings supplied with the tender shall be returned in good conditions along with the tender.

5.6 All drawings/sketches issued by the Architects/Consultant for the works are the property of the Architects/Consultant and shall not be lent, reproduced or used on any works other than intended without the written permission of the Architects/Consultant.

5.7 The Contractor shall maintain one set of all drawings issued to him as reference drawings. These shall not be used on site.

All corrections, deviations and changes made on the site shall be shown on these reference drawings for final incorporation in the completion drawings. All changes to be made shall be initialed by the Engineer-In-Charge /Owner.

6. **SHOP DRAWINGS**

6.1 The Contractor shall submit to the Consultant two copies of Shop Drawings for Plumbing works as an Advance Copy to the Engineer-in-Charge for approval before start of work. Subsequent to the approval of the shop drawings, the Contractor shall submit seven copies of Shop Drawings for execution to the Engineer-in-Charge. The Contractor shall also submit four copies of the Technical Specifications and Catalogues for all items, including pump curves, single line diagrams etc. as relevant.

6.2 All Sanitary Engineering drawings issued to the Contractor shall be studied by them. Contractor shall also obtain the necessary architectural, structural and other services drawings, based on which they shall prepare their shop drawings as per site conditions.

6.3 Shop drawings shall incorporate the following:

- All proposed Structural supports/hanging/laying and jointing details for all types of pipes as required.
- Typical details for Toilets & Fixtures required.
- Plumbing layout plans as required and for any changes in the layout of Plumbing/ Architectural Drawings.
- Equipment & piping layout for Mechanical and Electrical equipments as required, SLDs, mounting details of circuit breakers, location of panels, installation of terminals and faucets etc. w.r.t. finishes, surrounding levels & locations.
- Manufacturer's and Contractor's fabrication drawings
6.4 The Contractor can only commence the work after the approval of above documents by Project Manager/ Consultant.

6.5 Contractors shall ensure that the Shop drawings are approved by the Engineer-In-Charge / Owner / Consultant prior to any execution.

7. COMPLETION DRAWINGS & DOCUMENTS

7.1 On completion of work contractor shall submit one complete set of original tracings and two prints of “As Built” drawings for the Engineer-In-Charge. These drawings shall have the following information.

a) Run of all pipes with diameters and length on all floors and vertical stacks.

b) Ground and Invert levels of all Plumbing services pipes.

c) Location of all valves.

d) Location of all Mechanical equipment with layout and piping connection.

7.2 Contractor shall provide four sets of Test Certificate, Routine Type Test certificates for Motors, Dynamic balancing certificate for Impellers, Calibration certificate for instrument catalogues, Operation and Maintenance Manuals, performance data and list of spare parts supplied together with the name and address of the Manufacturers for all Mechanical and Electrical equipments provided by him in the form of a Book or Manual.

7.3 All "Warranty / Guarantee" cards / certificates in original issued by the manufacturers shall be handed over to the Engineer-In-charge also in the form of a comprehensive record book / documents.

8. MATERIALS (SUPPLIED BY THE CONTRACTOR)

8.1 All materials used in the works shall conform to the tender specifications.

8.2 As far as possible all materials shall be bearing I.S. certification marks as per approval of the Engineer-In-Charge.

8.3 All materials shall bear the necessary certification marks, conforming to the Tender Specifications / BOQ / Drawings requirements.

8.4 Unless otherwise specified and expressly approved in writing by the Engineer-In-Charge, materials of makes and specifications mentioned with tender shall be used.

9. INSPECTION AND TESTING OF MATERIALS

9.1 All materials before being allowed to be brought into the store will be preliminary / visually inspected at the entry gate of the project site before the security personnel. All materials shall be inspected by the Engineer-In-charge / Owner before receiving. This inspection will be conducted with the help of the quality approval format as prepared by the Clients.

9.2 Contractor shall be required, if requested, to produce manufacturers Test Certificate for the particular batch of materials supplied to him. The tests carried out shall be as per the relevant Indian Standards.
9.3 For examination and testing of materials and works at the site Contractor shall provide all Testing and Gauging Equipment necessary but not limited to the followings:-

a) Theodolite  
b) Dumpy level  
c) Steel tapes  
d) Weighing machine  
e) Plumb bobs, Spirit levels, Hammers  
f) Micrometers  
g) Thermometers, Stoves  
h) Hydraulic test machine  
i) Smoke test machine

9.4 All such equipment shall be tested for calibration at any approved laboratory, and the test and calibration certificate shall be submitted to the Engineer-In-Charge / Owner.

9.5 All Testing Equipment shall be preferably located in special room meant for the purpose.

10. MATERIALS SUPPLIED BY THE OWNER

10.1 The Contractor shall verify that all materials supplied by the Owner conform to the specifications of the relevant item in the tender. Any discrepancy found shall be brought to the notice of the Engineer-In-Charge.

10.2 After receipt of materials, it shall be the responsibility of the Contractor for any damage found and he shall be liable to pay the actual cost of the material as per market rate at that time.

11. RECOVERY OF COST FOR MATERIALS ISSUED TO CONTRACTORS FREE OF COST

If any materials issued to the Contractor, free of cost, are damaged or pilfered, the cost of the same shall be recovered from the Contractor on the basis of actual cost to the Owner which shall include all freight and transportation, excise duty, sales tax, octroi, import duty etc. or the actual cost given by the Owner shall be final and binding on the Contractor.

12. CONTRACTORS RATES

12.1 Rates quoted in this tender shall be inclusive of cost of materials, labor, supervision, erection, tools, plant, scaffolding, service connections, transport to site, taxes, octroi and levies, breakage, wastage, sales tax on works contract and all such expenses as may be necessary and required to completely do all the items of work and put them in a working condition.

12.2 Rates quoted are for all heights and depths required for this work.

12.3 All rates quoted must be for complete items inclusive of all such accessories, Fixtures and fixing arrangements, nuts, bolts, hangers as are a standard part of the particular item except where specially mentioned otherwise.
12.4 All rates quoted are inclusive of cutting holes and chases and making good the same with cement mortar/concrete of appropriate mix and strength as directed by Engineer-In-Charge.

12.5 Rates quoted shall be inclusive of cost incurred in testing, commissioning of works and materials.

12.6 Any required items not covered in BOQ, Specifications or Drawings, shall be paid extra only after getting the approval from Engineer-In-Charge / Owner. The rate analysis considering Cost Price, Labor, along with supporting documents / bills etc., shall be submitted to Engineer-In-Charge / Owner for approval.

13. **MOCK UP AND TRIAL ASSEMBLY**

The Contractor shall have to assemble a Mock up as instructed by the Engineer-In-Charge in order to determine precisely the required dimensions. Relevant instructions from manufacturers shall also be followed as applicable.

The Material can be reused for final installation without any additional payments for fixing or dismantling of these.

14. **EXECUTION OF WORK**

14.1 The work shall be carried out in conformity with the PHE drawings and within the requirements of Architectural, HVAC, Electrical, Structural consultant and other specialized services drawings.

14.2 The Contractor shall cooperate with all trades and agencies working on the site. He shall make provision for hangers, sleeves, structural openings and other requirements well in advance to prevent hold up of progress of the construction programme.

14.3. On award of the work, Contractor shall submit a programme of construction in the form of a Pert Chart or Bar Chart for approval of the Engineer-In-Charge / Owner. All dates and time schedule agreed upon should be strictly adhered to, within the stipulated time of completion/commissioning along with the specified phasing, if any.

14.4 Contractor shall be responsible for co-ordination with other agencies working on the project relating to their scope of work and shall take approval from the Engineer-In-Charge / Owner wherever required.

14.5 **Cutting & Making Good**

No structural member shall be chased or cut without the written permission of the Engineer-In-Charge.

15. **TESTING**

15.1 Piping and drainage works shall be tested as specified under the relevant clauses of the specifications.

15.2 Tests shall be performed in the presence of the Engineer-In-Charge / Consultant.
15.3 All materials and equipment found defective shall be replaced and whole work tested to meet the requirements of the specifications.

15.4 Contractor shall perform all such tests as may be necessary and required by the local authorities to meet Municipal or other by-laws in force.

15.5 Contractor shall provide all labour, equipment and materials for the performance of the tests.

15.6 Contractor shall afford all the expenses for the offsite testing of material and equipments.

15.7 All Material and Equipment shall be checked before installation and tested after installation.

16. SITE CLEARANCE AND CLEANUP

16.1 The Contractor shall, from time to time clear away all debris and excess materials accumulated at the site.

16.2 After the Materials, equipment and appliances have been installed and commissioned, Contractor shall clean-up the same and remove all plaster, paints stains, stickers and other foreign matter of discoloration leaving the same in a ready to use condition.

16.3 On completion of all works, Contractor shall demolish all stores, remove all surplus materials and leave the site in a broom clean condition, failing which the same shall be done at Contractors risk and cost.

17. FINAL INSTALLATION

The Contractor shall install all Material and Equipments in their final position in accordance with the approved trial assemblies and as shown on the Drawings. The installation of equipment shall be complete with all supply and waste connections.

Pipes shall be mounted rigid, plumb and true to alignment as per Drawings and Design requirements.

18. PROTECTION AGAINST DAMAGE

The Contractor shall take every precaution to protect all installed material and equipment against damage, misuse, cracking, staining, breakage and pilferage by providing proper wrapping and locking arrangement till the completion of the installation and handling over.

19. GUARANTEE / WARRANTY

19.1 The contractor shall submit a warranty for all equipment, materials and accessories supplied by him against manufacturing defects, malfunctioning or under capacity functioning.

19.2 The form of warranty shall be as approved by the Engineer-in-charge.
19.3 The warranty shall be valid for a period of one year from the date of commissioning and handing over.

19.4 The warranty shall expressly include replacement of all defective or under capacity equipment. Engineer-in-charge may allow repair of certain equipment if the same is found to meet the requirement for efficient functioning of the system.

19.5 The warranty shall include replacement of any equipment found to have capacity lesser than the rated capacity as accepted in the contract. The replacement equipment shall be approved by the Engineer-in-charge.

19.6 The contractor shall include in his rates the operation of all mechanical equipment for a period of one month from the date of commissioning. No separate payment will be made on this account.

C) EXCAVATION FOR PIPE LINE

1. EXCAVATION

The excavation for pipe works shall be open cutting unless the permission of the Project Manager for the ground to be tunneled is obtained in writing. Where sewers have to be constructed along narrow passages, the Project Manager may order the excavation to be made partly in tunnel and in such cases the excavated soil shall be stacked sufficiently away from the edge of Trenches & then brought back later on for refilling the trenches or tunnel.

Regarding Items of Archaeological interest such as relics of antiquity, coins, fossils etc. found at the site or obtained during excavation, the Project Manager shall be informed and items delivered immediately. Any other material obtained in such manner which in the opinion of the Project Manager is useful, shall be stocked properly as per the direction of the Project Manager.

1.1 Opening out Trenches

In excavation the trenches, etc. the solid road metalling, pavement, curbing etc. and turf is to be placed on one side and preserved for reinstatement when the trenches or other excavation shall be filled up. Before any road metal is replaced, it shall be carefully shifted. The surface of all trenches and holes shall be restored and maintained to the satisfaction of the Project Manager and the Owners of the roads or other property traversed and the Contractor shall not cut out or break down any live fence of trees in the line of the proposed works but shall tunnel under them, unless the Project Manager shall order to the contrary.

The Contractor shall clear the surface over the trenches and other excavations of all trees, stumps roots and all other encumbrances affecting execution of the work and shall remove them from the site to the approval of the Project Manager at his own cost.
1.2 **Obstruction of Roads**

The Contractor shall not occupy or obstruct by his operation more than one half of the width of any road or street and sufficient space shall then be left for public and private transit, he shall remove the materials excavated and bring them back again when the trench is required to be refilled. The Contractor shall obtain the consent of the Project Manager in writing before closing any road to vehicular traffic and the foot walks must be clear at all times.

1.3 **Removal of Filth**

All night soil, filth or any other offensive matter met with during the execution of the works, immediately after it is taken out of any trench, sewer or cess pool, shall not be deposited on to the surface of any street or where it is likely to be a nuisance or passed into any sewer or drain but shall be at once put into the carts and removed to a suitable place to be provided by the Contractor.

1.4 **Excavation to be Taken to Proper Depths**

The trenches shall be excavated to such a depth that the pipes shall rest on concrete or on firm bedding as described in the several clauses relating to these so that the inverts may be at the levels given in the sections. In bad ground, the Project Manager may order the Contractor to excavate to a greater depth than that shown on the drawings and to fill up the excavation to the level of the sewers with concrete, broken stone, gravel or other materials. For such extra excavation and concrete, broken stone, gravel or other materials, the Contractor shall be paid extra at rates laid down for such works in the schedule, if the extra work was ordered by the Project Manager in writing, but if the Contractor should excavate the trench to a greater depth than is required without a specific order to that effect in writing of the Project Manager the extra depth shall have to be filled up with concrete 1:5:10 mix (1 cement: 5 coarse sand: 10 stone aggregate 40mm nominal size) at the Contractor's own costs and charges to the requirements and satisfactions of the Project Manager. The excavated earth shall be beyond 1.5m away from the edges of the excavated Trenches.

1.5 **Refilling**

After the pipes or other work has been laid and proved to be water tight, the trench or other excavations shall be refilled. Utmost care shall be taken in doing this, so that no damage shall be caused to the sewer and other permanent work. The filling in the haunches and upto 75 cms above the crown of the sewer shall consist of the finest selected materials placed carefully in 15 cms layers and flooded and consolidated. After this has been laid, the trench and other excavation shall be refilled carefully in 20 mm layers with materials taken from the excavation, each layer being watered to assist in the consolidation unless the Project Manager shall otherwise direct.

1.6 **Contractor to Restore Settlement and Damages**

The Contractor shall, at his own costs and charges, make good promptly during the whole period the works are in hand, any settlement that may occur in the surfaces of roads, beams, footpaths, gardens, open spaces etc. Whether public or private caused by his trenches or by his other excavations and he shall be held responsible for any
accidents caused thereby. He shall also, at his own expenses and charges, repair and make good any damage done to buildings and other property. In case if he fails to make good such damages inspite of repeated instructions of the Project Manager the project Manager will be at liberty to get the damaged work done by any other agency at the risk and cost of the contractor and recover such amount from him from him running payments of the bills or by any other manner according to the law of the land.

1.7 Disposal of Surplus Soil

The Contractor shall at his own costs and charges provide places for disposal of all surplus materials not required to be used on the works. As each trench is refilled the surplus soil shall be immediately removed, the surface properly restored and roadways and sides left clear.

1.8 Timbering of Sewer and Trenches

a) The Contractor shall at all times support efficiently and effectively the sides of the sewer trenches and other excavations by suitable timbering, piling and sheeting and they shall be close, timbered in loose or sandy strata and below the surface of the sub soil water level.

b) All timbering, sheeting and piling with their waling and supports shall be of adequate dimensions and strength and fully braced and strutted so that no risk of collapse or subsidence of the walls of the trench shall take place.

c) The Contractor shall be held responsible and will be accountable for the efficiency of all timbering, branches, sheeting and piling used as also for all damage to persons and property resulting from improper quality, strength, placing, maintaining or removing of the same.

1.9 Shoring of Buildings

The Contractor shall shore up all buildings, walls and other structures, the stability of which is liable to be endangered by the execution of the work and shall be fully responsible for all damages to persons or property resulting from any accident. For which nothing extra will be paid.

1.10 Removal of Water from Sewer, Trench etc.

The Contractor shall at all times during the progress of the work keep the trenches and excavations free from water which shall be disposed off by him in a manner as will neither cause injury to the public health nor to the public or private property nor to the work completed or in progress nor to the surface of any roads or streets, nor cause any interference with the use of the same by the public.

1.11 Width and Depth of Trench

The Project Manager shall have power by giving an order in writing to the Contractor to increase the maximum width in respect of which payment will be allowed for excavation in trenches for various classes of sewer, manholes, and other works in certain lengths to be specifically laid down by him, where on account of bad ground or other unusual conditions, he considers that such increased widths are necessary in view of the site conditions.
1.12 Maximum width of pipes Trenches at the bottom of the Trench shall be as follows:

Maximum width of Trench = D + X

Where D is Outer dia of pipes

X= 300mm upto Trench depth of 1.50m & above 1.50m depth x is to be taken as
400mm for all diameter of pipes.

The maximum width of the bed concrete for sewers / drains shall also be same as above.

1.13 Refilling, Consolidation and Disposal of Surplus Earth

Rate quoted for excavation of trenches shall be inclusive of refilling, in 20cm layer & consolidation with water and disposal of surplus earth within a lead of 50m. No separate payment for refilling shall be made.

D) EXTERNAL SEWERAGE / DRAINAGE SYSTEM

1. SCOPE OF WORK

1.1 Work under this section shall consist of furnishing all Labor, Materials, Equipments and Appliances necessary and required to completely finish Sewerage/Drainage system as required by the drawings and specified hereinafter or given in the Schedule of Quantities.

1.2 Without restricting to the generality of the foregoing, the Sewerage & Drainage system shall include:

(A) Sewerage System

- Collection of Sewage from each unit
- Conveyance System including pipeline connection to chambers & manholes
- Connection to STP

(B) Drainage System

- Collection of run-off from each unit
- Conveyance of drainage from each unit excluding RCC Culverts
- Construction of collection chambers & manholes
- Rainwater Harvesting including rechargeable wells
- Final disposal to water bodies

2.0 GENERAL REQUIREMENTS

2.1 All materials shall be new of the best quality conforming to specifications and subject to the approval of the Engineer-in-Charge / Owner.

2.2 Drainage lines shall be laid to the required gradients and profiles.
2.3 All drainage work shall be done in accordance with the local Municipal byelaws.

2.4 Location of all manholes, catch basins etc., shall be got confirmed by the Contractor from the Engineer-in-Charge / Owner before the actual execution of work at site.

2.5 All works shall be executed as directed by Engineer-in-Charge / Owner.

3.0 ALIGNMENT AND GRADE

The sewer pipes shall be laid to alignment and gradient shown on the drawings but subject to such modifications as shall be ordered by the Engineer-in-Charge / Owner from time to time to meet the requirements of the works. No deviations from the lines, depths of cutting or gradients of sewers shown on the plans and sections shall be permitted except by the express direction in writing of the Engineer-in-Charge / Owner.

4.0 REINFORCED CEMENT CONCRETE PIPES

4.1 All underground storm water drainage pipes and sewer lines where specified (other than those specified cast iron) shall be centrifugally spun RCC pipes of specified class. Pipes shall be true and straight with uniform bore. Throughout cracked, warped pipes shall not be used on the work. All pipes shall be tested by the manufacturer and the Contractor shall produce, when directed a certificate to that effect from the manufacturer.

4.2 Laying

R.C.C. spun pipes shall be laid on cement concrete bed or cradles as specified and shown on the detailed drawings the cradles may be precast and sufficiently cured to prevent cracks and breakage in handling. The invert of the cradles shall be left 12mm below the invert level of the pipe properly placed on the soil to prevent any disturbance. The pipe shall then be placed on the bed concrete or cradles and set for the line and gradient by means of sight rails and bonding rods etc. cradles or concrete bed may be omitted, if directed by the Engineer-in-Charge / Owner.

4.3 Jointing

After setting out the pipes the collars shall be centered over the joint and filled in with tarred gaskin, so that sufficient space is left on either side of the collar to receive the mortar. The space shall then be filled with cement mortar 1:2 (1 cement: 2 fine sand) and caulked by means of proper tools all joints shall be finished at an angle of 45 degree to the longitudinal axis of the pipe on both side of the collars neatly.

5.0 CAST IRON PIPES FOR DRAINAGE

5.1 All drainage lines passing under building, floors and roads with heavy traffic, in exposed position above ground e.g. service floor and basement ceiling shall be cast iron pipes. Position of such pipes shall generally be shown on the drawings.

5.2 Cast iron pipes shall be centrifugally spun iron pipes conforming to I.S: 1536. Quality certificates shall be furnished.
5.3 **Fittings and Inspection Chambers**

a) Fittings used for C.I. drainage pipe shall conform to I.S: 1538. Wherever possible junction from branch pipes shall be made by a ‘Y tee’.

b) Cleanout plugs shall be provided on head of each drain and at location indicated on plans or directed by Engineer-in-Charge / Owner. Cleanout plugs shall be of size matching the full bore of the pipe. Plugs shall be made out with G.I. coupling caulked into the socket of the pipe or fittings. The end shall be provided with a brass screwed plug with suitable key for opening.

5.4 **Laying**

a) All cast iron pipes and fittings shall be jointed with best quality soft Pig Lead (conforming to IS: 782) which shall be free from impurities. In wet trenches joints shall be made from Lead Wool. Nothing extra will be paid for Lead Wool joints. Depth of pig lead and weight for joints shall be as given in I.S. code.

b) The spigot of pipe or fittings shall be centered in the adjoining socket by caulking. Sufficient turns of tarred gaskin to leave unfilled the required depth of socket for depth of 45mm when the gaskin has been caulked tightly home. Jointing ring shall be placed round the barrel and against the face of the socket. Molten Pig Lead shall then be poured to fill the remainder of the socket. This shall then be done in one pouring. The lead shall then be solidly caulked with suitable tools and hammers weighting not less than 2 kg.

c) For lead wool joints the socket shall be caulked with tarred gaskin, as explained above. The lead wool shall be inserted into the sockets and tightly caulked home skein by Gaskin with suitable tools and hammers of not less than 2 kg weight until joint is filled.

5.5 **Testing**

a) All lengths of the sewer and drain shall be fully tested for water tightness by means of water pressure maintained for not less than 30 minutes. Testing shall be carried out from manhole. All pipes shall be subjected to a test pressure of at least 1.5 meter head of water. The test pressure shall, however, not exceed 1.5 meter head at any point. The pipes shall be plugged preferably with standard design rubber plugs on both ends. The upper end shall, however, be connected to a pipe for filling with water and getting the required head. The tolerance figure of two liters per centimeter of dia per kilometer may be allowed during a period of ten minutes. Subsidence of the test water may be due to one or more of the following causes:

(i) Absorption by pipes and joints
(ii) Sweating of pipe or joints
(iii) Leakage at joints or from defective pipes

b) **Trapped Air**

Allowance shall be made for (i) by adding water until absorption has ceased after which the test proper should commence. Any leakage will be visible and the defective part of the work should be cut out and made good. A slight amount of sweating which is uniform may be overlooked, but excessive sweating from a particular pipe or joint shall be watched for and taken as indicating a defect to be made good.
c) Sewer and Drain Pipelines shall be tested for straightness by:

(i) Inserting a smooth ball 12mm less than the internal diameter of the pipe. In the absence of obstructions such as yarn or mortar projecting at the joints the ball should roll down the invent of the pipe and emerge at the lower end.

(ii) Means of a mirror at one end and a lamp at the other end. If the pipe line is straight the full circle of light will be seen otherwise obstruction of deviation will be apparent.

d) The Contractor shall give a smoke test to the drains and sewer at his own expense and charges, if directed by the Engineer-in-Charge / Owner.

e) A test register shall be maintained which shall be signed and dated by Contractor, Engineer-in-Charge / Owner and representative of Architects/ Consultants.

6.0 CEMENT CONCRETE & MASONRY WORKS FOR MANHOLES & CHAMBERS ETC.

6.1 Materials

a) Water

Acidity, Alkalinity and percentage of Solids shall be in accordance with IS: 3025. The Ph value shall generally be not less than 6. In general potable water is considered satisfactory for use. Sea water shall not be used.

Testing shall be done individually for different source points before the start of the work and there after once in every three months.

b) Aggregate for Concrete

It shall be strong, durable and free from adherent coatings, sea shell, organic impurities, disintegrated pieces.

If dirty, shall be washed with water before actual use. Flaky and elongated piece shall be avoided. It shall confirm to IS: 383 and IS: 2386.

c) Sand

It shall be hard, durable, chemically inert, clean and free from adherent coatings, organic matter etc. and shall not contain any appreciable amount of clay balls or pellets and harmful impurities and shall confirm IS: 2386. It shall not contain more than 8 % of silt as per the field test.

Grading for masonry, plaster and concrete shall be as per IS: 2116, IS: 1542, IS: 383 respectively, Sea sand shall not be used.

Testing for bulkage to be done and allowance be made at the time of use.

d) Cement

The cement used for all the constructional purposes shall be Portland pozzolana cement confirming to I.S. 1489 OR rapid hardening, Portland cement conforming to I.S. 269.

Tech. Specification - 92
Different types of Cement shall not be mixed together, shall be stacked and stored separately. Cement Bags shall be stacked in a manner to facilitate their removal and use in the order in which they are received.

The site where it is stored shall be dry, leak proof and as far as possible moisture proof.

Necessary precautions to be taken to avoid dampness through floor and walls. Stacking shall not be more than 10 bags high.

e) **Mild Steel Reinforcement**

   The mild steel for the reinforcement bars shall be in the form of round/ twisted/deformed bars conforming to all requirements of I.S. 432 (Grade I).

f) **Bricks**

   Brick shall have uniform color, thoroughly burnt, smooth rectangular faces, with parallel slab, sharp and right angled edges, but not over-burnt.

   When struck should give clear ringing sound.

   The maximum permissible area of perceptible deposit of efflorescence shall be 50% of the surface area of the Bricks. The affected bricks should not be more than 80% of the lot. There shall be no powdering or flaking of the surface.

   The average water absorption shall not exceed 22% by weight after 24 hours immersion in water.

   The average minimum compressive strength for bricks of class designation 75 shall not be less than 75 kg / cm².

g) **Other Materials**

   Other materials not fully specified in these specifications and which may be required in the work shall conform to the latest I.S. All such materials shall be approved by the Engineer-in-Charge / Owner before use.

6.2 **Cement Concrete (Plain or Reinforced)**

a) Cement concrete pipes bedding, cradles, foundations and RCC slabs for all works shall be mixed by a Mechanical mixer where quantities of the concrete poured at one time permit. Hand mixing on properly constructed platforms may be allowed for small quantities by the Engineer-in-Charge / Owner. Rate for cement concrete shall be inclusive of all shuttering and centering at all depth and heights.

b) Concrete work shall be of such thickness and mix as given in the Schedule of Quantities.

c) All concrete work shall be cured for a period of at least 7 days. Such work shall be kept moist by means of gunny Bags at all times. All pipe trenches and foundations shall be kept dry during the curing period.
6.3 **Masonry Work**

Masonry work for manholes, chambers, brick masonry pipe trench and such other works as required shall be constructed from 1st class bricks as specified in the Schedule of Quantities in cement mortar 1:4 mix (1 cement: 4 coarse sand). All joints shall be properly raked to receive plaster.

6.4 **Cement Concrete for Pipe Support**

b) Wherever specified or shown on the drawings, all pipes shall be supported in concrete bed all round or in haunches. The thickness and mix of the concrete shall be given in the Schedule of Quantities. Type of the bedding is as described as follows:

c) Unless otherwise directed by the Engineer-in-Charge / Owner cement concrete for bed, all round or in haunches shall be laid as follows:-

<table>
<thead>
<tr>
<th>Description</th>
<th>Upto 3 M depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipes in open ground (No sub soil water)</td>
<td>All round (1:5:10)</td>
</tr>
<tr>
<td>Pipes (all) in sub soil water condition</td>
<td>All round (1:3:6)</td>
</tr>
<tr>
<td>Pipes under the building or at road crossing or under public places</td>
<td>All round (1:2:4)</td>
</tr>
</tbody>
</table>

(1=1=1 cement, 2-3-5=coarse sand, 4-6-10 stone aggregate 20/40mm nominal size)

d) R.C.C. pipes or C.I. pipes, may be supported on brick masonry or precast R.C.C or Cast insitu cradles. Cradles shall be as shown on the drawings.

e) Pipes in loose soil or above ground shall be supported on brick or RCC anchor blocks as shown on the drawings.

7. **MANHOLES AND CHAMBERS**

7.1 All manholes, chambers and other such works as specified shall be constructed in brick masonry in cement mortar 1:4 (1 cement: 4 coarse sand) or as specified in the Schedule of Quantities.

7.2 All Manholes, Chambers, etc., shall be supported on base of cement concrete of such thickness and mix as given in the Schedule of Quantities or shown on the drawings.

Where not specified, Manholes may be constructed as follows:-

(All dimensions internal clear in cms) (As / BMC Regulation)
<table>
<thead>
<tr>
<th>Size of Manhole Type</th>
<th>90x80 Rect.</th>
<th>120X90 Rect.</th>
<th>91 dia Circular</th>
<th>122 dia Circular</th>
<th>140 dia Circular</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum depth</td>
<td>120</td>
<td>160</td>
<td>167</td>
<td>230</td>
<td>Any depth beyond 230</td>
</tr>
<tr>
<td>Average thickness of R.C.C slab</td>
<td>15</td>
<td>15</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Size of cover and frame (Internal dia)</td>
<td>61x45.5</td>
<td>56 dia</td>
<td>56 dia</td>
<td>56 dia</td>
<td>56 dia</td>
</tr>
<tr>
<td>Weight of cover and frame not less than</td>
<td>38 Kg. or as specified</td>
<td>116 Kg. or 170 Kg. or 208 Kg. or as specified in BOQ</td>
<td>116 Kg. or 170 Kg. or 208 Kg. or as specified in BOQ</td>
<td>116 Kg. or 170 Kg. or 208 Kg. or as specified in BOQ</td>
<td>116 Kg. or 170 Kg. or 208 Kg. or as specified in BOQ</td>
</tr>
<tr>
<td>Type of Cover &amp; Frame</td>
<td>C.I</td>
<td>C.I. or SFRC as specified in BOQ.</td>
<td>C.I. or SFRC as specified in BOQ.</td>
<td>C.I. or SFRC as specified in BOQ.</td>
<td>C.I. or SFRC as specified in BOQ.</td>
</tr>
</tbody>
</table>

7.3 All manholes shall be provided with cement concrete benching in 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20mm nominal size). The benching shall have a slope of 10cm towards the channel. The depth of the channel shall be full diameter of the pipe. Benching shall be finished with a floating cost of neat cement.

7.4 All manholes shall be plastered with 12/15mm thick cement mortar 1:3 (1 cement: 3 coarse sand) and finished with a floating coat of neat cement inside. Manhole shall be plastered outside as above but with rough plaster.

7.5 All manholes with depths greater than 1 M. shall be provided with plastic encapsulated 20mm square or 25mm round rods foot rungs set in cement concrete blocks 25 x 10 x 10cms in 1:2:4 mix 30cms vertically and staggered. Foot rests shall be coated with coal tar before embedding.

7.6 All manholes shall be provided with cast iron covers and frames and embedded in reinforced cement concrete slab or SFRC precast concrete covers as per instructions of the Engineer-in-Charge / Owner. Weight of cover, frame and thickness of slab shall be as specified in the Schedule of Quantities or as given above.

7.7 All catch basins shall be having C.I. grating or SFRC precast Gully Grating as per instructions of Engineer-in-Charge / Owner. The grating along with frame shall be of approved design and quality as per instruction of Engineer-in-Charge/ Owner.
8.0  **MAKING CONNECTIONS**

Contractor shall connect the new sewer line to the existing manhole by cutting the walls, benching and restoring them to the original condition. A new channel shall be cut in the benching of the existing manhole for the new connection. Contractor shall remove all sewage and water if encountered in making the connection without additional cost.

9.  **COMMISSIONING**

9.1 After successful testing of the different sewerage and drainage pipes in parts, the Contractor shall provide all facilities including necessary pipings, labours, tools and equipments etc. for carrying out testing and commissioning of the entire external sewerage and drainage system complete as per requirement in the presence of Client representative/Consultant, whenever and as may be required. Generally, the following test/inspection has to be carried out:-

(a) For any Leakages/seepages in the external sewerage and drainage pipes.

(b) For checking the functioning of the entire external sewerage and drainage system including rainwater harvesting system and to ensure that the waste water is continuously flowing towards outfall without any intermediate stagnation.

(c) For the functioning of the valves and accessories etc. by putting ON/OFF the controlling valves of the various diversions in the sewerage and drainage and rain water harvesting system.

E) **WATER SUPPLY SYSTEM**

1. **SCOPE OF WORK**

1.1 Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install the water supply system as required by the drawings, specified hereinafter and given in the bill of quantities.

1.2 Without restricting to the generality of the foregoing, the water supply system shall include the following:-

- Domestic Water Main Distribution System from plant room to various units of entire campus.
- Tubewell Rising Main to Plant Room
- Flushing Water Distribution System from STP to various units in the entire campus.
- External Garden Hydrant System including Garden Hydrant points in connection from treated effluent from STP & rainwater from water bodies.
- Construction of control valves, masonry chambers & all other appurtenances.
- External Hydrants on water distribution as required.

2. **GENERAL REQUIREMENTS**

2.1 All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Engineer-in-Charge / Owner.
2.2 Pipes and Fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

2.3 Short or Long bends shall be used on all main pipe lines as far as possible. Use of Elbows shall be restricted for short connections. As far as possible all Bends shall be formed by means of a hydraulic pipe bending machine for pipes up to 65mm dia.

2.4 Pipes shall be fixed in a manner so as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

2.5 Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.

2.6 Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.

3. UPVC PIPES

3.1 UPVC Pipes

UPVC pipes confirming to I.S: 4985 and of the class as specified in bill of quantity. The details of the nominal outer diameter, weight and working pressure at 20° C shall be as per the above standards, for the respective pressure rating as specified in the B.O.Q.

All pipes shall be straight and smooth and inside free from irregular bore, blowholes, cracks and other manufacturing defects

3.2 Jointing of PVC Pipes

UPVC pipe as per I.S: 4985 shall be jointed with solvent cement as per manufacturer’s specifications and relevant I.S. codes.

Pipes shall be tested after installation for a pressure equal to twice the maximum working pressure in the line or as per manufacturers specifications or as specified subsequent relevant codes.

4. DUCTILE IRON PIPES

Ductile Iron Pipes for water supply mains shall be ductile iron grade-I, cement mortar lined conforming to IS : 8329 as classified in BOQ

4.1 Ductile Iron Pipe Fittings & Inspection Chambers

Fittings used for DI pipes shall conform to IS: 9523, BS: EN: 545/1995, Class ‘A’. The fittings shall have external bitumen coating and internal cement mortar lining.

5. G.I. PIPES & FITTINGS

5.1 All pipes where specified as G.I. pipes shall be galvanized steel tubes conforming to I.S. 1239-1979 of class specified. When class is not specified they shall be medium class.

5.2 Fittings shall be malleable iron galvanized fittings, of approved make. All fittings shall have manufacturer’s trade mark stamped on it. Fittings for G.I. pipes shall include
Couplings, Bends, Tees,Reducers, Nipples, Unions, Bushes, Fittings shall be of I.S:1879 - (part I to X) 1975.

5.3 Pipes and fittings shall be jointed with screwed fittings. Care shall be taken to remove burr from the end of the pipe after cutting by a round file. Genuine red lead with grumet and a few strands of fine hemp shall be applied. All pipes shall be fixed in accordance with layout and alignment shown on the drawings. Care shall be taken to avoid air pockets. G.I. pipes inside toilets shall be fixed in wall chases well above the floor. No pipes shall be run inside a sunken floor as far as possible. Pipes may be run under the ceiling or floors and other as shown on drawings.

6. CLAMPS

G.I. pipes in shafts and other locations shall be supported by M.S. clamps of design approved by Engineer-in-Charge / Owner. Pipe in wall chases shall be anchored by iron hooks. Pipes at ceiling level shall be supported on structural clamps fabricated from M.S. structural as described in the sub section. Pipes in typical shafts shall be supported on Slotted Angles/Channels as specified elsewhere.

7. UNIONS

Contractor shall provide adequate number of unions on all pipes to enable dismantling later. Unions shall be provided near each Gunmetal Valve, Stop Cocks, or Check Valves and on straight runs as necessary at appropriate locations as required and/or directed by Engineer-in-Charge / Owner.

8. FLANGES

Flanged connections shall be provided on pipes where shown on the drawings, all equipment connections as necessary and required or as directed by Engineer-in-Charge / Owner. Connections shall be made by the correct number and size of the bolts and made with 3 mm thick insertion rubber washer. Where hot water or steam connections are made insertion gasket shall be of suitable high temperature grade and quality approved by Engineer-in-Charge / Owner. Bolt hole dia for flanges shall conform to match the specification for C.I. Sluice Valve to I.S. 780.

9. TRENCHES

The galvanized iron pipes and fittings shall be laid in trenches. The width and depth of the trenches for the different diameters of the pipes shall be as follows:

<table>
<thead>
<tr>
<th>Dia of Pipe</th>
<th>Width of Trench</th>
<th>Depth of Trench</th>
</tr>
</thead>
<tbody>
<tr>
<td>15mm to 50mm</td>
<td>30 cms</td>
<td>60 cms</td>
</tr>
<tr>
<td>65mm to 100mm</td>
<td>45 cms</td>
<td>75 cms</td>
</tr>
</tbody>
</table>
At joints the trench width shall be widened where necessary. The work of excavation and refilling shall be done true to line and gradient in accordance with general specifications for earthwork in trenches.

When excavation is done in rock, it shall be cut deep enough to permit the pipes to be laid on a cushion of sand minimum 7.5 cm deep.

10. **PAINTING**

10.1 All surfaces shall be thoroughly cleaned before painting.

10.2 All pipes above ground shall be painted with one coat of Red Lead and two coats of Synthetic Enamel paint of approved shade and quality. Pipes shall be painted to standard color code specified by Engineer-in-Charge/Owner.

10.3 All pipes in chases and below floor shall be provided Anti-corrosive treatment.

11. **PIPE PROTECTION**

Where specified in the Schedule of Quantities all pipes below ground shall be protected against corrosion by wrapping 100mm wide and 4mm thick layer of material of approved make over the pipe.

12. **VALVES**

12.1 **Gunmetal Valves**

a) Valves 65mm dia and below shall be heavy Gunmetal Fullway Valves or Globe Valves or Ball valves conforming to I.S. 778-1971 of 20 Kg/cm² class. Valves shall be tested at manufacturer’s works and the same stamped on it.

b) All Valves shall be approved by the Engineer-in-Charge / Owner before they are allowed to be used on work.

12.2 **Ball Valves**

Ball Valves have body material as Forged Brass Chrome plated with Spindle Brass Nickel Plating & Lever handle Steel Chrome plated with green plastic cover. The valve is suitable for water maximum working pressure up to 25 bar (PN 25). The valve is operated by turning. The rotation from open to close is a quarter turn (90°) which closes in a clock-wise direction.

12.3 **Butterfly Valves**

a) Butterfly valves of approved quality for pressure rating of 230 P.S.I. with locking arrangement and gearbox with handle operated or gearbox with lid shall be provided or as given in the Bill of Quantities.

b) Butterfly valves shall be of specified quality conforming to IS: 13095 or BS: 5155.
c) Joints for butterfly valves shall be made with suitable tail/socket pieces on the pipe line and flanged joints made with 3mm thick insertion rubber gasket with appropriate number of bolts, nuts and washers.

d) Butterfly valves shall be provided on all branches as shown in the drawings or as specified.

12.4 Sluice Valves

a) All valves 80mm dia and above shall be C.I. Double Flanged Sluice Valves. Sluice valves shall be Cast Iron double flanged, with rising spindle. Each sluice valve shall be provided with wheel for valves in exposed positions and Cap Top for underground valves. Contractor shall provide suitable operating keys for Sluice Valves with Cap Tops.

b) Sluice valves shall be of best quality conforming to I.S: 780-1969 of class specified.

c) Sluice valves shall be socketed type or double flanged type conforming to I.S: 780.

d) Joints for socketed valves shall be lead-caulked joints as specified above.

e) Joints for double flanged sluice valves shall be made with suitable tail/socket pieces on the pipeline and flanges joints made with 3 mm thick insertion rubber gasket made with 3 mm thick insertion rubber gasket with appropriate number of bolts, nuts and washers.

f) Sluice valves shall be installed at all branches and as shown on the drawings.

12.5 Scour Valves

Scour valves shall be C.I. sluice valves as specified above. They shall be installed at the lowest level or tail end of the system as shown on drawings and directed by Engineer-in-Charge / Owner.

12.6 Air Release Valves

(a) Air release valves shall be single acting type air valves with cast iron body and bronze/gunmetal internal parts and plastic float.

(b) Each air release valve shall be provided with a cast iron isolating sluice valve of specification given above.

13. VALVE CHAMBERS

13.1 Contractor shall construct chambers for all full way valves, butterfly valves and other type of valves as specified in the Bill of Quantities. These shall be made, in brick masonry in cement mortar 1:4 (1 cement: 4 coarse sand) on cement concrete foundations 150mm thick 1:5:10 mix (1 cement: 5 coarse sand: 10 graded stone aggregate 40mm nominal size) 12 mm thick cement plaster 1:3(1 cement : 3 coarse sand) inside finished with a floating coat of neat cement with 8mm thick M.S surface box with hinged cover and locking arrangement, 150 mm thick reinforcement cement concrete top slab of 1:2:4 (1 cement : 2 coarse sand: 4 graded stone aggregate 20mm nominal size), as specified and shown in drawings, including excavation, back filling rammed complete or as specified in Bill of Quantities.

13.2 Valve chambers shall be constructed as specified in BOQ but generally shall be of following sizes:
14. **EXTERNAL YARD HYDRANTS**

The Contractor shall provide External Fire Hydrant in the Water supply distribution Ring, as specified in Schedule of Quantities and as shown in drawings. The spacing of the hydrants and the distance from the building shall be maintained as shown on the drawings.

15. **TESTING**

15.1 All pipes, fittings and valves shall be tested by hydrostatic pressure of min. 1.5 times the working pressure and subject to minimum of 9 kg/cm² in any case and with the consent of Engineer-in-Charge / Owner.

Pressure shall be maintained for a period of at least two hours without appreciable drop in the pressure after fixing at site. (±10 %). A test register shall be maintained and all entries shall be signed and dated by Contractor(s) and Engineer.

15.2 In addition to the sectional testing carried out during the construction, Contractor shall test the entire installation after connections to the overhead tanks or pumping system or mains. He shall rectify all leakages, and shall replace all defective materials in the system. Any damage done due to carelessness, open or burst pipes or failure of fittings shall be made good during the defects liability period without any extra cost.

15.3 After completion of the water supply system, Contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. Valves which do not effectively operate shall be replaced by new ones at no extra cost and the same shall be tested as above.

16. **DISINFECTION**

16.1 After completion of the work Contractor shall flush clean the entire distribution systems with filtered water after connection has been made.

16.2 After the first flushing, commercial bleaching powder is to be added to achieve a dosage of 2 to 3 mg/l of water in the system added and flushed. This operation should be performed twice to ensure that the system is fully disinfected and usable.

17. **PRE COMMISSIONING**

17.1 Ensure that all pipes are free from debris and obstructions.

17.2 Check all valves and fire hydrant for effective opening and closing action. Defects should be rectified or valves replaced.

17.3 Ensure that all Connections to Branches has been made.
17.4 Ensure that mains have been connected to the respective pumps, underground and overhead tanks or as per requirements.

17.5 All main line Valves should be closed.

18. COMMISSIONING

18.1 Fill Underground tank with water. Add 1kg fresh bleaching powder after making a solution to be added near inlet.

18.2 Start Water Supply Tubewell / Municipal flow and allow water to fill main Underground tank. Water will first fill the fire tank and then overflow to the Raw Water tanks.

18.3 Run the Pumps with all water treatment accessories or Bypass.

18.4 Fill the domestic water tanks and run main supply pumps.

18.5 Release water in the main lines by opening Valves in each circuit. Drain out water in the system through scour valves or fire hydrant in lower regions. Ensure clean water is now coming out of the system.

18.6 Open valves for individual clusters. Observe for leakages or malfunctions, check pressure & flow at end of line by opening Hydrants etc. Remove and rectify defects noticed.

18.7 Check all outlet points for proper operation by opening each valve and allowing water to flow for a few minutes. Also check for effective closure of valve.

18.8 The entire water supply system should be disinfected with bleaching powder and system flush cleaned.

18.9 Send four samples of water drawn from four extreme locations for testing for bacteriological test in sterilized bottles obtained from the concerned laboratory. (Laboratory personal may collect the samples themselves).

19. RESPONSIBILITY

Responsibility for various activities in pre-commissioning and commissioning procedures will rest with the Contractor.

F) WATER SUPPLY PUMPS, EQUIPMENTS, WATER TREATMENT

1. PUMPS AND WATER TREATMENT EQUIPMENT

1.1 Work under this sub-head consists of furnishing all labour, with appropriate T&P scaffolding & staging as required to completely install pumping system for various water supply services and water treatment as per drawings, specified hereinafter and given in the Bill of Quantities.

1.2 Without restricting to the generality of the foregoing, the work of pumps and water treatment equipment shall include the followings:
• Raw Water Pumps
• Treatment Units
• Re-lift Pumps & Equipments & all other related accessories

2. PUMP SET

2.1 Water Supply Pumps

(These specifications are applicable for all clear water pumps and as specified in schedule of Quantities)

2.1.1 Water supply pumps shall be suitable for clean water. Pumps shall be multistage, Inline vertical, centrifugal pumps with SS casing, stainless steel impeller, stainless steel shaft, CI base with CED coating and directly coupled with TEFC induction motor of class "F" insulation & efficiency class EFF-1, 2900 RPM, IP 55 enclosure, suitable for operation on 415 volts ±10%, 3 phase, 50 Hz, A.C. supply. Each pump should operate a curve 10m below specified head. Tenderers shall select their drivers within 10% to 15% in excess of the maximum B.H.P of the pump plus transmission losses if any.

2.1.2 Pump and motor shall be mounted on a common M.S. structural or C.I. base plate or as required as per site conditions.

2.1.3 Each pumping set shall be provided with a 150mm dia or of suitable size gunmetal "Bourden" type pressure gauge with gunmetal isolation cock and connecting piping.

2.1.4 Provide vibration-eliminating pads appropriate for each pump.

2.1.5 Provide vibration eliminators/expansion joints on suction and Discharge side of the Pump and wherever required.

2.1.6 Provide rate of flow measuring meter with bypass arrangement with every set of pumps as shown on the drawings and given in the bill of quantities (to be paid separately).

2.1.7 All water supply pumps shall be provided with mechanical seals of required specifications.

2.2 Installation

Pump shall be installed as per manufacturer's recommendations. Pump sets shall be mounted on machinery isolation cork or any other equivalent vibration isolation fitting. The vibration isolation pads, foundation bolts etc. shall be supplied by the Contractor. Contractor shall ensure that the foundation bolts are correctly embedded.

Pump-sets shall preferably be factory aligned, wherever necessary, site alignment shall be done by competent persons.

2.3 Testing

Tenderers shall submit the performance curves of the pumps supplied by them. They shall also check the capacity and total head requirements of each pump to match his own piping and equipment layout. On completion of the entire installation, pumps shall be tested, wherever possible, for their discharge, head, flow rate, B.H.P. Where it is not
possible at least the discharge, head and B.H.P. (as measured on the input side) shall be field tested. Test results shall correspond to the performance curves.

2.4 **Painting**

After complete installation and testing, pumps accessories and fittings shall be given two coats, three mils each of approved finishing paint.

3. **SUMP PUMPS**

3.1 Sump pumpset shall be compact, mono-block, dry motor submersible type with class “F” insulation of suitable capacity & RPM operating on 415volt ± 10%, 3 phase, 50Hz AC supply, with non-clog free flow open CI impellers, CI casing (Pump & Motor) and having solid handling capacity of required size for lifting domestic sewage or muddy water/drainage as specified in schedule of Quantities.

3.2 Pump shall inclusive of all necessary accessories like valves, piping, Control Panel and Cabling, Level Controllers, Test and/or air vent cocks, gland drain etc. as required within the quoted cost. The Contractor has to ensure for smooth and trouble free operation after the commissioning of the entire system. Nothing shall be paid extra on this account.

3.3 The pump shall automatically operate with high water level and stop at low water level in the sump by means of “Electronic Level Controller”, with necessary control cabling of the approved make upto control panel.

3.4 The sump pumps shall be complete in all respect and shall be installed manufacturer’s recommendations. All accessories shall be In-Built as per manufacturer’s specification.

3.5 Contractor shall provide Electrical control panel having all necessary accessories, safety devices, Ammeter & voltmeter of approved make & standard specifications and shall be suitable for receiving incomer armoured cable to connect complete within the quoted cost.

4. **HYDRO PNEUMATIC SYSTEMS**

4.1 **Hydro pneumatic systems (With Variable Frequency Drive)**

4.1.1 The scope of this section covers supply, installation, testing and commissioning of compact packaged type skid mounted, self contained variable frequency drive hydro pneumatic system. The skid mounted, factory assembled hydro-pneumatic system shall be provided with pressure transmitters, frequency convertor for noiseless operation of the pump at varying duty point. The convertor shall be provided with short circuit safety, earthing, over current, under voltage protection. The system shall comprise of multiple pumps working and one stand-by to meet the system discharge requirements.

4.1.2 It shall conform the following specifications:

a) Pumps shall be vertical, inline multistage centrifugal and fulfils all specifications specified in para 3.1 "Water supply pumps".

b) Pressure vessel shall be of non corrosive FRP composite construction lined with NSF and/or FDA listed material, like high density polyethylene with fully replaceable
polyurethane. Air cell burst pressure of minimum of five times the vessel operating pressure and cycle tested for 2,50,000 cycles with charging connections to discharge pipe line with necessary flanges, gaskets, isolating valve, nuts/ bolts etc. with suitable foundation bolts & other accessories, complete. Capacity provided shall be as per manufacture specifications.

c) Panel mounted microprocessor multi pump controller with large graphical display and variable frequency drive (VFD) mounted inside a panel complete with pressure sensor transmitter. The graphical display is capable to show number of pumps running & also communicate with other controllers following with open protocol through RS485 port. System should be capable to compensate for frictional losses at lower flows. All alarms should be displayed in the controller. The panel should also have provision for manual / automatic alternate (cyclic) operation of pumps, ON/OFF switch, inter connecting power and control cabling etc complete.

4.2 Control Panel (For Hydro pneumatic systems Without VFD)

The control panel shall have terminals for:

a) Remote monitoring.
b) Pump fault
c) Analog output signal for frequency convertor (In case of VFD operated Hydro pneumatic systems).
d) Pressure sensor / Pressure switches as per system requirement

4.3 General

The hydro pneumatic system shall be capable of maintaining a constant pressure at varied consumption. The hydro pneumatic system shall be complete with pressure sensor and microprocessor based controller for flow control by means of frequency variation (in case of VFD operated system). The controller should have time control switch to adapt pump operation to actual requirement in peak load situation. The control panel should also have manual operation.

The pumping system shall perform the following functions:

- Shut off the pump at zero demand.
- Shut off the pump at zero suction (Dry Run protection)
- Protect the pump from overvoltage, under voltage, overload & earth fault.
- Vary the time of pump speed acceleration and deceleration (For VFD operated Hydro pneumatic system).
- Compensate for higher friction losses at high flow rates.
- Send out a signal for remote monitoring of flow as well as pressure.
- Conduct automatic test run of pumps at set times.
- Keep track of run time for pumps.
- Perform run time equalization of all pumps in system.

4.4 Installation

Hydro pneumatic systems shall be mounted on a common base frame & installed as per manufacturer's recommendations. Pump sets shall be mounted on machinery isolation cork or any other equivalent vibration isolation fitting. The vibration isolation pads, foundation bolts etc. shall be supplied by the Contractor. Contractor shall ensure that the foundation bolts are correctly embedded.
5. **WATER FILTERS**

5.1 Water filter shall be of dual media pressure filter (comprising of minimum 300mm bed depth of Anthracite and support media and minimum Height on Straight 1500mm) of downward or upward flow type suitable for a rate of filtration given in Schedule of quantities.

5.2 Filter shall be vertical type of required diameter. The shell shall be fabricated from M.S. plate suitable to withstand a working pressure of 3 Kg/cm². The minimum thickness of shell will be 10mm and dished ends shall be 12mm. The quality of Steel shall be as per IS:2062 Grade B, thickness as per ASME Section 8. The filter shall have at least one pressure tight manhole cover.

Filter shall be provided with screwed or flanged connections for inlet, outlet, individual drain connections and all other connections necessary as required. Filter shall be painted inside with two or more coats of coal tar epoxy paint, one coat of red oxide primer outside with two or more coats of synthetic enamel paint of approved shade.

The Filter media shall comprise of 0.5 to 1.00 mm fine filtering silica sand for removal of turbidity and suspended matter.

The initial charge of filter media as specified in above para’s shall be the responsibility of contractor.

The pressure filter shall be complete with cleaning cycle controller adjustable to meet application requirement, actuating control valves in required sequence for back wash.

5.3 **Under Drain System**

Filter shall be provided with an efficient under drain system comprising of collecting pipes, gunmetal/polypropylene nozzles of manufacturer's design. The entire under drain system be provided on M.S. Plate or cement concrete supports.

5.4 **Face Piping**

Filter shall be provided with interconnecting face piping comprising of inlet, outlet, and backwash pipe complete with pipes, valves and accessories, as per requirement. Piping shall be G.I. piping, heavy duty, as per I.S: 1239 and valves shall be cast iron double flanged sluice valves with C.I. body and Neoprene rubber diaphragm.

5.5 **Accessories**

Each filter shall be provided with following accessories:-

a) Air release valve with connecting piping.

b) 150mm dia dial bourden type gunmetal pressure gauges with gunmetal isolation cock and connecting piping on inlet and outlet.

c) SS Sampling cocks on raw water inlet and filtered water outlet.
d) Individual drain connection with gunmetal fullway valve should be piped through a properly sized G.I. pipe to nearest drain point.

6. **WATER SOFTENER**

6.1 Softener shall be designed to give zero commercial hardness. Softener shall be with “cation” ION exchange resins.

6.2 Softener vessel shall be of mild steel plate with dished ends and self supporting arrangement. Vessel shall be suitable for a minimum working pressure of 3 Kg/ Sq. cm. The vessel shall be tested at 1.5 times the working pressure. The shell shall be designed to allow a minimum free board space at 50% of the mineral bed depth for adequate expansion during back washing. The shell shall have a minimum thickness of 10mm and dished ends 12mm. The quality of Steel shall be as per IS:2062 Grade B, thickness as per ASME Section 8. All internal parts of the softener shall be rubber lined as per approved specifications rubber lined and externally with one coat of red oxide and two or more coats of synthetic enamel paint of approved shade.

6.3 The vessel shall have an internal collecting and distribution system of manufacturer's design.

6.4 The softener shall have a set of interconnecting face piping consisting of inlet, outlet and brine injection system with valves and accessories complete as per requirement. Piping shall be G.I heavy duty, as per I.S: 1239 and valves shall be cast iron double flanged sluice valves with C.I. body and Neoprene rubber diaphragm. Individual drain connection with gunmetal full way valve should be piped through a properly sized G.I. pipe to nearest drain point.

6.5 The brine injection system consist of hydraulic ejector with control valve, brine delivery pipes with adjustable indicator.

6.6 One measuring tank (Brine Tank) having a capacity of minimum one regenerations or as specified in bill of quantities.

6.7 One orifice board for indicating wash and rinse rate to be fitted in drain sump.

6.8 One initial charge of supporting gravel, sand and “cation” ION exchange resin in requisite quantity.

6.9 One water testing kit with instructions for testing water samples.

6.10 One rotameter to indicate flow rate.

6.11 Inlet & outlet pressure gauges.

7. **SALT SATURATOR ASSEMBLY**

7.1 The High density Polyethylene (HDPE) tanks each of 5000 ltrs capacity consist of automatic agitator for holding and supplying salt for softener with inlet & outlet piping with valves and accessories complete as per requirement.
The automatic agitator shall be motorized (motor of suitable rating operating on single phase, 50 Hz, AC supply) having Stainless steel shaft with fan blade, coupled with suitable gear box duly mounted MS Frame with Epoxy Coating.

7.2 The transfer Pump for supplying salt solution to softener shall be of multistage, Inline vertical, centrifugal pumps with cast iron/cast steel body, SS316L stage casing, SS316L impeller, stainless steel shaft, and directly coupled with TEFC induction motor of class "F" insulation & efficiency class EFF-1, 2900 RPM, IP 55 enclosure, suitable for operation on 415 volts ±10%, 3 phase, 50 Hz, A.C. supply.

7.3 The contractor has to ensure that the effective capacity of the system shall be of minimum 10% greater than actual salt required for approx. 3 Days with complete structural arrangement including suitable foundation bolts & other accessories etc.

8. CHLORINATOR

Chemical dosing should consist of electronic / electro mechanical metering pump with suction and delivery flexible connections and fittings. The pump shall be mounted on FRP tank of required capacity having in-built basket for holding alum blocks and lime blocks. The system should be completed with electrically operated single phase motor driven stirrer having stainless steel shaft. This should be suitable for working against a pressure of 1.5 kg/Sq.cm and should be capable of ejecting Sodium Hypo-chloride solution with a dose of 1 ppm.

9. PIPING

9.1 Scope

The scope of this section comprises the Supply, Laying, Erection, Testing and Commissioning of pipes required for this project.

9.2 Pipes & Jointing

Pipes for suction and delivery shall be galvanized steel pipes (heavy duty) confirming to I.S:1239 upto 150mm dia and as per I.S:3589 for dia 200mm and above or as specified in bill of quantities. Galvanising shall conform to IS 4736. Pipes and fittings shall be jointed with screwed/flanged joints, flanges either screwed or welded complete and jointed with 3mm thick rubber gasket as per requirements complete with nuts, bolts and washers etc.

9.2.1 All Fittings shall be new and from reputed manufacturers, Fittings shall be of malleable iron galvanized of pressure ratings suitable for the piping system. Fitting for G.I. pipes shall include couplings, bends, tees, reducers, nipples, unions, bushes.

9.3 Piping Installation

9.3.1 Clamps

G.I. pipes shall be supported by M.S. clamps of design approved by Engineer-in-charge. Pipes in wall chases shall be anchored by iron hooks. Pipes at ceiling level shall be supported on structural clamps fabricated from M.S. structural.
Contractor shall provide adequate number of unions on all pipes to enable easy dismantling later when required. Unions shall be provided near each gunmetal valve, stop cock, or check valve and on straight runs as necessary at appropriate locations as required and / or directed by Engineer-in-charge.

9.3.3 Flanges

The M.S flanges shall confirm to I.S:6392-1971 and shall be galvanized. Flanged connections shall be provided on pipes as required, all equipment connections as necessary and required or as directed by Engineer-in-charge. Connections shall be made by the correct number and size of the bolts and made with 3mm thick insertion rubber washer. Bolt hole dia for flanges shall conform to match the specification.

9.3.4 Piping layout shall take due care for expansion and contraction in pipes.

9.3.5 All pipes using screwed fittings shall be accurately cut to the required sizes. Care shall be taken to remove Burr from the end of the pipe after cutting by a round file. Genuine red lead with grumet and a few strands of fine hemp shall be applied and threaded in accordance with IS: 554. Open ends of the piping shall be locked as the pipe is installed to avoid entrance of foreign matter. Wherever reducers are to be made in horizontal runs, eccentric reducers shall be used if the piping is to drain freely, in other locations, concentric reducers may be used.

9.3.6 Contractor shall provide suitable cement concrete, anchor blocks of adequate dimensions as per spacing mentioned above & at all bends, tee connection and other places required and necessary for overcoming pressure thrusts in pipes wherever pipes are installed on-ground / underground. Anchor blocks shall be of cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size).

9.3.7 Drain shall be provided at all low points in the piping system and shall be of the following sizes:

<table>
<thead>
<tr>
<th>Mains</th>
<th>Drains</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upto 300mm dia</td>
<td>25mm dia</td>
</tr>
<tr>
<td>Over 300mm dia</td>
<td>40mm dia</td>
</tr>
</tbody>
</table>

Drains shall be provided with forged brass ball valve of equal size. Drains shall be piped through equal size G.I. pipe to the nearest drain or floor waste or as shown on the drawings. Piping shall be pitched towards drain points.

9.3.8 Vibration Elimination:

Piping installation shall be carried out with vibration elimination fittings wherever required.

9.4 Testing

9.4.1 All pipes, fittings and valves shall be tested by hydrostatic pressure of min. 1.5 times, the working pressure and subject to minimum of 10 kg/cm2 in any case and with the consent of Project-in-Charge.

9.4.2 Pressure shall be maintained for a period of at least two hours without appreciable drop in the pressure after fixing at site. A test register shall be maintained and all entries shall be signed and dated by Contractor(s) and Engineer.
9.5 **Painting**

9.5.1 After the piping has been installed, tested and run for at least ten days. The piping shall be given two finish coats, 3 mils each of approved color.

9.5.2 The direction of flow of fluid in the pipes shall be visibly marked in white arrows or as directed by the Engineer-in-charge.

10. **VALVES & ACCESSORIES**

10.1 **Sluice / Gate Valves**

Sluice Valves above 65 mm (inside screw and non raising screw type) shall be of Cast Iron body and Gunmetal seat with double flanged ends and valve wheel. They shall conform to type PN 1.6 of IS:780. Sluice valves upto 65mm (outside screw raising spindle type) shall be of Gunmetal Full way Valve with wheel tested to 20 Kg./cm² class-II as per I.S: 778 with female screwed ends. Valve wheels shall be of right hand type and have an arrow head engraved or cast thereon showing the direction for turning open and close.

10.2 **Butterfly Valves**

10.2.1 The Butterfly Valve shall be suitable for waterworks. The Valves conforming to IS : 13095 shall be provided. All valves shall be suitable to withstand the pressure in the system and rating shall be PN 1.6. All valves shall be right handed (i.e. handle or key shall be rotated clock wise to close the valve).

10.2.2 The direction of opening and closing shall be marked and an open / shut indicator fitted.

10.2.3 The material of valves shall be as under:-

<table>
<thead>
<tr>
<th>Body</th>
<th>Cast iron</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disc</td>
<td>Ductile Iron</td>
</tr>
<tr>
<td>Seat</td>
<td>EPDM / nitrile rubber</td>
</tr>
<tr>
<td>Shaft</td>
<td>Stainless Steel</td>
</tr>
</tbody>
</table>

10.2.4 The Valve shall be fitted between two flanges on either side of pipe flanges. The Valve edge rubber shall be projected outside such that they are wedged within the pipe flanges to prevent leakages.

10.3 **Non-Return Valve**

Non-return valves shall be of Cast Iron body and Stainless Steel seat. They shall conform to API-594 and have companion flanges. They shall be Dual Plate Type suitable for both horizontal and vertical installation. An arrow mark in the direction of flow shall be marked on the body of the valve.
10.4 **Air Release Valve**

Air valves shall be provided at all high points in the piping system for air vent of the double float type, with G.M. body, vulcanite balls, rubber sealing, etc. Air valves shall be of the sizes specified and shall be associated with an equal size forged ball valve.

10.5 **Ball Valve**

10.5.1 The Ball Valve shall be made from forged brass and tested to 20 Kg/cm² pressure. The valve shall be internally threaded to receive pipe connections.

10.5.2 The Ball shall be made from brass and machined to perfect round shape and subsequently chrome plated. The seat of the valve body bonnet gasket and gland packing shall be of Teflon.

10.5.3 The handle shall be of chrome plated steel with PVC jacket. The handle shall also indicate the direction of ‘open’ and ‘closed’ situations. The gap between the ball and the teflon packing shall be sealed to prevent water seeping upto 14 Kg / cm² pressure.

10.5.4 The handle shall also be provided with a lug to keep the movement of the ball valve within 90 degree.

10.6 **Strainer**

Strainers shall be preferably of the approved type with fabricated steel bodies designed to the test pressure of 10 Kg/cm². Strainers shall be fabricated by minimum 1.2 mm thick stainless steel sheet with 3 mm dia. perforation holes. Strainers shall be provided with flanges or threaded sockets as required. They shall be designed so as to enable blowing out accumulated dirt and facilitate removal and replacement of screen without disconnection of the main pipe.

10.7 **Pressure Gauges**

Pressure gauges shall be of 150mm dia. dial and of appropriate range and be complete with shut off gauge valve etc. duly calibrated before installation. Care shall be taken to protect pressure gauges during pressure testing.

10.8 **Flexible Connection for Pumps**

All suction and delivery lines shall be provided with double flanged reinforced neoprene flexible pipe connectors. Connectors should be suitable for a working pressure of each pump. Length of the connector shall be as per manufacturer’s details.

11. **ELECTRICAL CONTROL PANELS**

11.1 **Motor Control System**

The main switchboard shall be floor mounted, free standing, cubical type, compartmentalized and shall be factory built fabricated by one of the approved switch board manufacturer. The board shall be fabricated from 2mm thick CRCA sheet and powder coated after seven tank process. The board shall be fabricated with IP 54 degree of protection suitable for operation of 415 volt ± 10%, 3 phase,4 wire,50Hz, AC supply. The switch board shall have provision for termination of cables from top as well as bottom with suitable knockouts. The layout shall be designed for convenient connections and inter-connections with various switchgears. Connections from
individual compartments to cable alleys shall be such as not to shut down healthy circuits in the event of maintenance work becoming necessary on a defective circuit. A base channel of 75mm 5mm thick shall be provided at the bottom. A maximum of 200mm space between the floor and bottom most panel of unit shall be provided. The bus bar shall be of aluminum complete with heat shrinkable PVC sleeves. The fabrication of switch board shall be taken up only after the drawings for the fabrication of the same are approved by the Engineer –in –charge.

Control panel shall contain starters and safety protection for different types of pump motors & various feeders alongwith its controls. It shall also house the switchgears for incoming as well for outgoings supply. Provision of voltmeter ( for incomer ) & ammeter for incomer as well as for other feeders with selector switch, a set of LED indicating light for incoming phases as well as status indication of each equipment as per the schedule of quantities. The voltmeter & indication lamps shall be protected by MCBs.

The feeders for all those motors having more than 7.5 HP capacity shall be provided with fully automatic Star Delta starters with motor duty MCCBs for short circuit protection only(ICS = 100% ICU ) & Overload Relays with contactors of suitable range & ratings, for overload protection, while less than or equal to 7.5 HP motor shall have Motor protection circuit breaker(MPCB) with over load & short circuit protection of suitable rating. Single phase preventers shall be provided for all 3 phase motors. Single phase preventer shall be in conformity with relevant ISI standards. Single phase preventers shall act when the supply voltage drops down to 90 % of the rated voltage or failure of one or more phases.

Single phase preventer shall be voltage operated and of approved make.

Other feeders of the panel which don’t require starter, shall be housed with:

i) MCCB with Thermal magnetic release & should provide adjustable setting for overload and short circuit protection with ICS = 100% ICU.

ii) MCB used for controlling shall be with tripping characteristics of C curve. The miniature circuit breakers shall be 1/2/3/4 pole as per requirement. The breaking capacity of MCBs shall have minimum 10KA.

ON-OFF switches for each motor / equipment should not be provided on the cover of the control panel. But at the same time interlocking shall be provided between switch and the door in such a way that the door of the panel cannot be opened when the supply is ON.

The panel shall be provided all identification tags, danger board etc as per IS standard.

All control panels shall be provided with detailed control circuit diagram indicating the terminal numbers and color coding of the wires used in the panels. This diagram shall be pasted on the inner side of the cover and protected with PVC transparent lamination.

All MCCBs / MPCB’s shall be equipped with extended front operated rotary handles on the doors. Rotary handle should have provision for pad lock.

Outgoing from each of the MCCB shall be extended to the cable alley by providing necessary busbar of suitable rating and supports etc. for terminating the outgoing feeders.
The detailed specification of switch gears and other accessories shall follow as described in Package A of these tender specifications.

12. **PUMP MOTOR CONTROLLER CUM WATER LEVEL INDICATING PANEL**

The Pressure Transducers shall be used for water level measurement, and it shall be convenient to mount on the water tanks. Hydrostatic pressure level sensors shall be submersible or externally mounted pressure sensors suitable for measuring the level of liquids in deep tanks or water in reservoirs. Level measurement shall be based on the pressure measurement principal, also referred to as hydrostatic tank gauging (HTG). It shall work on the principle that the difference between the two pressures \(d/p\) is equal to the height of the liquid \(h\) (in inches) multiplied by the specific gravity \(SG\) of the fluid.

\[d/p = h(SG)\]

Therefore, the Transducers reading will represent the tank level. These sensors sense increasing pressure with depth and because depth is proportional to Volume for a regular tank, the Volume of Water can be easily calculated using a PLC.

The Centralized PLC control panel shall be front operated, cubicle construction, wall mounted type, fabricated out of 1.6 mm thick CRCA Sheet, with hinged lockable doors, dust and vermin proof, powder coated of approved shade, inter-connections, having, internal wiring, earth terminals, Top / Bottom control cable entry, numberings etc. comprises of touch-screen display board (Minimum Diagonal size 8") along with all accessories for complete Programmable logical controls & indications, having necessary interlocks, Inputs/Outputs, required number of repeater amplifiers, all audio-visual alarms as per the requirements listed below i/c emergency stop push button on the panel etc. The panel shall have BMS compatible with open protocol.

12.1 **Water Level Indicators & Controllers**

The hydrostatic pressure sensor (Water level indicator) is working on hydrostatic pressure measurement principle made of Stainless Steel for installation in storage tanks, and capable of providing 4 to 20 mA analog signal compatible with PLC signal inputs and all control outputs to MCC panel (Plumbing/Water supply), for various water tanks as per the schedule of quantities.

13. **POWER / CONTROL CABLEING**

Contractor shall provide all power /control cables from the motor control centre to various motors, level controllers and other control devices. All power cables shall be aluminum conductor XLPE insulated, armoured and PVC sheathed. Therefore all control cables shall be of copper conductor, PVC insulated, armoured and PVC sheathed. All cables shall have stranded conductors of 1100 Volt grade. The cables shall be in drums as far as possible and bear manufacturer’s name.

Specification of cable laying shall be followed as described in Package A of this tender. Cables and wires in conduits shall be laid on the metallic trays.

14. **CABLE TRAYS**

Specification of cable trays shall be followed as described in Package A of this tender.
15. **EARTHING**

Main Electrical power upto the Electrical panel(s) in Pump Room along with earthing shall be provided by other agency.

All three phase motors / equipment shall be earthed with two independent earth conductors as per the requirement of Indian Electricity Rules and Regulation - 1956.

Earthing specifications shall be followed as described in Package A of this tender.

16. **MEASUREMENTS**

16.1 Pipes for suction and delivery header and mains shall be measured per linear metre along the centre line of the pipe and shall be inclusive of all fittings.

The rates for piping work shall include all wastage allowances, flanges pipe supports, hangers, excavation, refilling, testing, nuts and check nuts, vibration isolators, suspension where specified or required, and any other item required completing the pipe installation. None of these items will be separately measured and paid.

16.2 Cable trays and cables shall be measured per linear meter.

16.3 No separate payment shall be made for making connections of the existing service lines to the pumps. Vibration eliminators and anti vibration mounting pads are included in the scope of supply and installation.

17. **COMMISSIONING**

After successful testing of the different items in parts, the Contractor shall provide all facilities including necessary piping, labour, tools and equipments etc. for carrying out testing and commissioning of the entire water treatment plant complete as per requirement in the presence of Engineer-In-charge or his representative whenever and as may be required. Generally, the following test/inspection has to be carried out:

G) **SEWERAGE TREATMENT PLANT**

1. The job of STP has to be done on a Turnkey basis, therefore the contractor shall be fully responsible for designing, preparation of drawings and calculations, supply of material, installation, testing and commissioning, getting final certifications related to the final quality of treated effluent, from all the concerned Pollution & Environmental Authorities & Operation and Maintenance of the system for the mentioned period.

2. Proposed Capacity of STP is 120 m3/day.

3. Generally but not limited to the following main activities are expected from the Executing Agency in a sequential manner.
   i) Preparation of scheme based on the design data & guidelines given in the documents and getting it approved from the consultant.
   ii) Preparation of detailed Shop drawings, Technical Documents and getting it approved from the consultant.
   iii) Makes of all Electro – Mechanical components shall also get approved from the consultant.
4. **DESIGN DATA**

(The data as provided below are only for guideline purposes and are to be verified by the Executing Agency)

4.1 **Site Location:** The site is located in Jammu

4.2 **Air Temperatures**

(a) Annual mean Max. : 47.2°C (June)

(b) Annual means Min. : 0.6°C (January)

4.3 **Rainfall**

Normally rains occur between June to September.

(a) No. of rainy days : 48.9 days

(b) Average Annual rainfall : 1008.7 mm

4.4 **Wind**

From February to August the wind direction is prevalently North-Westerly to Westerly & from September to January it is mainly Easterly to North Easterly.

4.5 **Ground Water**

To be verified from the site.

4.6 **Soil Characteristics**

To be verified from the site.

4.7 **Accessibility of Site**

The site is well connected by all-weather roads from all directions.

4.8 **Construction Material Available**

As the site is well connected by all-weather roads construction material can easily be available at site. Skilled and unskilled laborers are available.

5. **INFLUENT CHARACTERISTICS**

5.1 **Type of Waste Water:** The influent is the product of the wastewaters from different activities such as:

(a) Domestic sewage from the toilets & bathrooms.

(b) Oil, Grease and food waste from Pantries etc.

*The influent characteristics indicated are only for guideline purpose.*
5.2 Daily Flow : 120 Cum./day.
5.3 Duration of flow to STP : 24 hours
5.4 Temperature : Maximum 45°C
5.5 pH : 7.15 to 8.2
5.6 Color : Mild
5.7 T.S.S (mg/l) : 200 to 250
5.8 BOD (mg/l) : 200 to 250
5.9 COD (mg/l) : 300 to 400
5.10 Oil & Grease : 10 - 50 mg/lit.

6. TREATED EFFLUENT CHARACTERISTICS AFTER SECONDARY TREATMENT
6.1 pH : 7.2 to 7.8
6.2 Oil & Grease : < 10 mg/l
6.3 B.O.D : 10-20 mg/l
6.4 C.O.D : 20 to 50 mg/l
6.5 Total suspended solids : 15 to 30 mg/l

7. Final Effluent Characteristics after Tertiary Treatment
7.1 pH : 7.1 to 7.3
7.2 Oil & Grease : Absent
7.3 B.O.D : Less than 10 mg/l
7.4 C.O.D : Less than 20 mg/l
7.5 Total suspended solids : NIL / Not Detectable

7.6 It may clearly be understood that the client wants to make re-use of treated effluent. The water after above treatment shall go for flushing, horticulture purposes. The water from the tertiary treatment shall be re-used. Hence, it is imperative that the contractor ensures that the effluent is usable for above purposes. The effluent shall also be suitable for constructional purposes, and hence shall conform to quality of water as per IS: 456.

8. DESCRIPTION OF TREATMENT PROCESS AND UNITS
8.1 Without restricting to the generality of the foregoing, the work shall consist of:-
8.2 Design & commissioning of all MS components, to consist of:-
c) MBBR tank
d) Tube Settler
e) Clarified water tank
f) Treated water tank
g) Sludge holding tank

8.3 Mechanical Equipment

Design, supply, erection, commissioning and testing of all mechanical equipments, as discussed in the proceeding sections, generally comprising of:

a) Basket Screen
b) Root Air blowers with motor and related accessories.
c) Air Diffusers.
d) Raw effluent re-lift pumps, Sludge return pump, Sludge Loading Pump, filter feed pump
e) Basket type Centrifuge & Sludge handling arrangements
f) All Pipe-line and valves
g) Chlorine dosing pump
h) Poly Dosing Pump
i) Multigrade Sand Filter
j) Activated carbon Filter
k) UV treatment system
l) Drainage sump pumps from STP plant room area.
m) Any other equipment required for functioning of STP or as per Clients' requirements.

8.4 Electrical Equipment

Design, Supply, Erection, Commissioning and Testing of all Electrical equipment generally comprising of:

a) Electric motors for all equipments as required.
b) Motor control center completes with all internal wiring and accessories.
c) Electrical cables from M.C.C panel to all electric motors and units.
d) Electric earthing stations as per I.E.E. rules.
e) All internal lighting & exhaust system etc.

8.5 Piping Work

Laying of all piping work as per detailed designs and generally for:

a) All above mentioned civil structure and tanks.
b) For the interconnection of the various equipments, sludge sump, pump house and control room.
c) All interconnecting piping between various units bypass etc.
d) Effluent piping within limits as shown on the drawings.
e) Piping required for providing water supply & drainage for the Testing Laboratory.

8.6 Treatment Process

Tech. Specification - 117
8.6.1 The treatment process is aimed to convert the influent quality as mentioned in the above sections, into the required quality standards so that the treated effluent can be re-used for non-potable uses such as Flushing, Horticulture. It is proposed to perform the treatment of the effluent by the biological aerobic process. The process is designed to induce the growth of bacteria, which by physical and physio-chemical action retain the organic pollution and live on it. This growth is obtained by putting a bacterial culture disposal as a flock in suspension in the effluent inside a stirrer, i.e. MBBR tank.

8.6.2 To have an efficient treatment system, an aeration system is proposed using with MBBR/bio-media, to reduce the HRT and storage capacity for Reactor Tanks. MBBR is a complete mix, continuous flow through process which combines the benefits of fixed film and suspended growth processes. Benefits include increased treatment capacity, improved settling characteristics, enhanced process stability, and reduced sludge production.
SECTION –C– TECHNICAL SPECIFICATIONS FOR INTERNAL & EXTERNAL ELECTRICAL WORK

 SCOPE OF WORK

The Scope of work shall be for following buildings :-

• Assistant Professor Residence (24 Nos.)

The Items / activities covered under Internal & External Electrical Works shall be include the followings :-

(i). Meter Boards & Final Distribution Boards for Assistant Professor Residence Building

(ii). Point wiring of all light, light plug points, fan points, & general power points, AC Point, including modular type light and power accessories etc. complete in all respects.

(iii). Light fixtures, ceiling fans & wall/ Cabin fans.

(iv). Conduiting and wiring for telephone System including tag blocks complete with telephone cabling between tag blocks & telephone outlets etc. as required.

(v). External Lighting of roads, pathways with light fixtures complete with Feeder Pillars, cabling, poles, earthing etc. as required.

(vi). Earthing of electrical installation complete in all respect.

(vii). Scope of work shall include supply, installation, testing & commissioning of complete electrical system installation as described above.

It is not the intent to specify completely here in all aspects of design and constructional features of equipments and details of the work to be carried out, nevertheless, the equipment and work shall conform in all respects to high standards of Engineering, design and workmanship and shall be capable of performing in continuous commercial operation in a manner acceptable to the owner who will interpret the meaning of the specifications and drawings and shall have right to reject or accept any work or material which in his assessment is not complete to meet the requirement of these specifications and or applicable codes and standards mentioned else where in these specifications.

1.0 GENERAL

These conditions of contract are meant to amplify the specifications, schedule of quantities and drawings in addition to those conditions specified from time to time as additions or omissions to those said general conditions of contract. In case of non conformation, the later shall supersede the general conditions of contract.

It is not the intent to specify completely here in all aspects of design and constructional features of equipments and details of the work to be carried out, nevertheless, the equipment and work shall conform in all respects to high standards of Engineering, design and workmanship and shall be capable of performing in continuous commercial operation in a manner acceptable to the CPWD or Project Managers (PMC) who will interpret the meaning of the specifications and drawings and shall have right to reject or accept any work or material which in his assessment is not complete to meet the
requirement of these specifications and or applicable codes and standards mentioned elsewhere in these specifications.

2.0 REGULATIONS AND STANDARD.

The installation shall conform in all respects to Indian Standard Code of Practice for Electrical Wiring Installation IS:732-1989; Code of practice for Fire safety of Building (general) Electrical Installation IS 1646:1997; and as per CPWD general specification for Electrical Works (Part I, II & IV). It shall also be in conformity with the current Indian Electricity Rules and regulations in so far as these become applicable to the installation. Wherever this specification calls for a higher standard of material and/or workmanship than those required by any of the above regulations then this specification shall take precedence over the said regulation and standards.

3.0 SUBMISSION OF TENDERS

The tender shall be submitted complete with the following :-

a) Complete tender documents as purchased from Department / CPWD duly filled in and signed. The price part of the tender shall be indicated only on the tender schedule of work.

b) Earnest money deposit in one of the acceptable forms as specified.

c) Any other supplementary details required for the evaluation of the tenders such as drawings, technical literature / catalogues, data etc.

d) Deviations, if any, from tender specifications and / or tender conditions, with reasons. Therefore, it is open to the department whether or not to accept them.

4.0 RATES

The work shall be treated as on works contract basis and the rates tendered shall be for complete items of work inclusive of all taxes (including works contract tax, service tax, VAT and any other taxes), duties, and levies etc. and all charges for items contingent to the work, such as, packing, forwarding, insurance, freight and delivery at site for the materials to be supplied by the contractor, watch and ward of all materials including those supplied by Department / CPWD / Project Managers (PMC) for the work at the site etc.

Prices quoted shall be firm. Price adjustments shall however be governed by Clause 10C /10cc of the Conditions of contracts given in form CPWD 7 or 8 of the tender documents, for work executed under these forms. All relevant documents shall be produced by the contractor of the Engineer in – charge, whenever called upon by him to do so, for working out such adjustment in rates.

5.0 TAXES AND DUTIES

a) Being an indivisible works contract, sales tax, excise duty etc. are not payable separately.

b) Works Contract tax, Service tax, VAT, Octroi duty and any other taxes for the work shall be included within the quoted rates for the various items.

c) The works contract tax shall be deducted from the bills of the contractor, if applicable in the State in which the work is carried out.

Tech. Specification - 120
d) Octroi shall not be paid separately for the materials supplied by the contractor, but the Department, on demand, can furnish octroi exemption certificate. However, the Department is not liable to reimburse the octroi duly in case the concerned authorized do not honor such exemption certificates.

6.0 COMPLETENESS OF TENDER
All sundry fittings, assemblies, accessories, hardware items, foundation bolts, termination lugs for electrical connections as required, and all other sundry items which are useful and necessary for proper assembly and efficient working of the various components of the work shall be deemed to have been included in the tender, whether such items are specifically mentioned in the tender documents or not.

7.0 WORKS TO BE ARRANGED BY THE DEPARTMENT / CPWD / PROJECT MANAGERS (PMC)
Unless and otherwise specified in the tender documents, the following works shall be arranged by the Department / CPWD / Project Managers (PMC):-

i) Storage space for all equipments, components and materials for the work.
ii) Supply of material to the contractor as stipulated in the tender documents.

8.0 WORKS TO BE DONE BY THE CONTRACTOR
Unless and otherwise mentioned in the tender documents, the following works shall be done by the contractor, and therefore their cost shall be deemed to be included in their tendered cost:-

i) Foundations for equipments and components where required, including foundation bolts.
ii) Cutting and making good all damages caused during installation and restoring the same to their original finish.
iii) Sealing of all floor openings provided by him for pipes and cables, from fire safety point of view, after laying of the same.
iv) Painting at site of all exposed metal surfaces of the installation other than pre-painted items like fittings, fans, switchgear/distribution gear items, cubicle switch board etc. and erection, shall however be rectified to the satisfaction of the Engineer-in-charge.
v) Testing and commissioning of completed installation.

9.0 STORAGE & CUSTODY OF MATERIAL
Suitable and lockable storage accommodation shall be provided by the Department free of cost to the contractor. However, the watch and ward of the stores and their safe custody shall be their safe custody shall be his (Contractor) responsibility till the final taking over the of the installation by the Department.

10.0 ELECTRIC POWER SUPPLY AND WATER SUPPLY
Unless and otherwise specified, power supply and water supply will be arranged by the contractor at the site of installation purpose

However, for testing purpose, electrically supply will be made available free of cost to the contractor.
Contractor will make due care to ensure safety to Electrical installation during execution of work

11.0 **MOBILIZATION ADVANCE**
No mobilization advance shall be paid for the work unless otherwise stipulated tender paper for any individual work.

12.0 **TOOLS FOR HANDLING AND ERECTION**
All tools and tackles required for handling of equipments and materials at site of work as well as for their assembly and erection and also necessary test instruments shall be the responsibility of the contractor.

13.0 **CO-ORDINATION WITH OTHER AGENCIES**
The contractor shall co-ordinate with all other agencies involved in the building work so that the building work is not hampered due to delay in his work. Recessed conduit and other works which directly affect the progress of building work should be given priority.

14.0 **CARE OF BUILDING**
Care shall be taken by the contractor to avoid damage to the building during execution of his part of work. He (Contractor) shall be responsible for repairing all damages and restoring the same to their original finish at his cost. He shall also remove at his cost all unwanted and waste material arising out of his work from the site.

15.0 **STRUCTURAL ALTERATION TO BUILDING**

a) No structural member in the building shall be damaged / altered, without prior approval from the competent authority through the Engineer–in–charge.

b) Structural provision like openings cutouts if any provided by the department for the work shall be used. Where these require modifications or where fresh provision are required to be made, such contingent works shall be carried out by the contractor at his cost.

c) All such openings in floors provided by the Department shall be closed by the contractor after installing the cable / conduits /rising mains etc. as the case may be by any suitable means as approved by the Engineer –in – charge without any extra payments.

d) All chases required in connections with the electrical works shall be provided and filled by the contractor at his own cost to the original architectural finish of the buildings.

16.0 **ADDITION TO AN INSTALLATION:**
Any addition temporary or permanent to the existing electrical installation shall not be made without a properly worked out scheme / design by a qualified Electrical Engineer to ensure that such addition does not lead to overloading, safety violation to the existing system.

17.0 **INSPECTION OF MATERIAL AND EQUIPMENT :**

a) Material and equipment to be used in the work shall be inspected by the Departmental officers. Such inspection will be of followings categories.

- Inspection of materials/ equipments to be witnessed at the Manufacturer’s premises in accordance with relevant BIS / Agreement Inspection Procedure.
• To receive material at site with Manufacturer’s Test Certificates.
• To inspect material at the Authorized Dealer’s Godowns to ensure delivery to genuine materials at site.
• To receive materials after physical inspection at site.

b) The department officers will take adequate care to ensure that only tested and genuine material of proper quality are used in work.

c) Similarly, for fabricated equipments, the contractor will first submit dimensional detailed drawings for approval before fabrication is taken up in the factory. Suitable stage inspection at factory also will be made to ensure proper used workmanship and quality control.

d) The tender specifications will stipulate the inspection requirements or waiver for various materials / equipments including norms of inspection in specific cases.

18.0 RATING OF COMPONENT

(a) All components in a wiring installation shall be of appropriate ratings of voltage, current and frequency, as required at the respective sections of the electrical installation in which they are used.

(b) All conductor switches and accessories shall be of such size as to be capable of carrying the maximum current, which will normally flow through them, without their respective ratings being exceeded.

19.0 CONFORMING TO STANDARDS

All components shall conform to relevant Indian Standard Specifications, wherever existing. Materials with ISI certification mark shall be preferred.

A broad list of relevant Indian Standard is given in Appendix D (General Specification for Electrical works Part I – Internal 2005). These Indian Standards, including amendments or revision thereof up to the date of tender acceptance, shall be applicable in the respective contracts.

20.0 INTERCHANGEABILITY:

Similar parts of all switches, lamp holders, distribution fuse boards switch gears, ceiling roses, brackets, pendants, fans and all other fittings of the same type shall be interchangeable in each installation.

21.0 WORKMANSHIP:

a) Good workmanship is an essential requirement to be complied with. The entire work of manufacturer / fabrication, assembly and installation shall conform to sound engineering practice.

b) PROPER SUPERVISION / SKILLED WORKMEN:

The contractor shall be licensed electrical contractor of appropriate class suitable for execution of the electrical work. He shall engage suitably skilled / licensed workmen of various categories for execution of work supervised by supervision / Engineer or appropriate qualification and experience to ensure proper execution of work. They will carry out instructions of Engineer – in-charge and other senior officers of the Department during the progress of work.

c) USE OF QUALITY MATERIALS.

Only quality material of reputed make as specified in the tender will be used in work.
d) **FABRICATION IN REPUTED WORKSHOP**

Switch board and L.T. panel shall be fabricated in a factory / workshop having modern facilities like quality of fabrication, seven tanks process powder / epoxy paint plant, proper testing facilities, manned by qualified technical personnel.

The tender shall specify some quality make of fabricators shall with modern facilities of design, fabrication and testing capable of delivering high quality L.T. Panel and switch board after testing as per relevant specifications.

22.0 **TESTING**

All testes prescribed in these General Specification, to be done before, during and after installation, shall be carried out and the test result shall be submitted to the Engineer – in – Charge in prescribed performa, forming part of the Complete Certificate.

23.0 **COMMISSION ON COMPLETION:***

After the work is completed, it shall be ensured that the installation is tested and commissioned.

24.0 **COMPLETION PLAN AND COMPLETION CERTIFICATE :***

a) For all work completion certificate after completion of work as given in Appendix E (General Specification for Electrical works Part I – Internal 2005) shall be submitted to the Engineer – in – charge.

b) Completion plan drawn to a suitable scale in tracing cloth with ink indication the following, along with three blue print copies of the same shall also be submitted.

- General layout of the building.
- Location of main switchboard and distribution boards, indicating the circuit number controlled by them.
- Position of all points and their controls.
- Types of fittings viz. fluorescent, pendants brackets, bulk head, fans and exhaust fans etc.
- Name of work, job number, accepted tender reference actual date of completion, names Division/ Sub-Division, and name of the firm who executed the work with their signature.

25.0 **DRAWINGS :***

(a) The work shall be carried out in accordance with the drawings enclose with the tender documents and also in accordance with modification thereto from time to time as approved by the Engineer – in – charge.

(b) All wiring diagram shall be deemed to be Drawings with in meaning of the term as used in Clause 11 of the conditions of contract (PWD7 or PWD8). They shall indicate the main switch board, the distribution boards (with circuit number controlled by them), the runs of various mains and sub mains and he position of all points with their controls.

(c) All circuits shall be indicated and numbered in the wiring diagram and the points shall be given the same number as the circuit to which the are electrically connected.

26.0 **CONFORMITY TO IE ACT, IE RULES AND STANDARDS**

All electrical works shall be carried out in accordance with the provisions of Indian Electricity act, 1910 and Indian Electricity Rules 1956 amended up to date (Date of call
of tender unless specified otherwise). List of Rules of Particular importance to Electrical Installation under these General Specifications is given in Appendix C (General Specification for Electrical works Part I – Internal 2005) for reference.

27.0 **GENERAL REQUIREMENT OF COMPONENT:**

All materials and equipments supplied by the contractor shall be new. They shall be of such design, size and materials as to satisfactorily function under the rated conditions of operation and to withstand the environmental conditions at site.

28.0 **GUARANTEE**

The installation will be handed over to the Department / CPWD / Project Managers (PMC) after necessary testing and commissioning. The installation will be guaranteed against any defective design/ workmanship. Similarly, the material supplied by the contractor will be guaranteed against any manufacturing defect, inferior quality. The guarantee period will be for a period of 12 months from the date of handing over to the Department. Installation/ equipments or components thereof shall be rectified / repaired at the discretion of the Engineer-in-charge.

29.0 **DRAWINGS**

The drawings indicate the extent and general arrangements of the fixtures, controlling switches, wiring system etc. and are essentially diagramatic. The drawings indicate the points of termination of conduit runs and broadly suggest the routes to be followed. The work shall be executed as indicated in the drawings, however any minor changes found essential to co-ordinate the installation of this work with the other trades shall be made without any additional cost to the Department. The drawings are for guidance of the Contractor and exact locations, distance and levels shall be governed by the building. The Contractor shall examine all architectural, structural, plumbing and sanitary & electrical drawings before starting the work and report to the Engineer-in-Charge any discrepancies which in his opinion appear on them and get it clarified. Contractor shall not be entitled to any extras for omissions or defects in electrical drawings or when they conflict with other services work. The contractor shall prepare working drawings and get it approved from the Engineer-in-charge before commencing the work.

30.0 **CONDUIT**

Prior to the laying of the conduits, contractor shall submit to the Engineer-in-Charge detailed layout plans of the conduit and trunking network and get the same approved. The layout plan shall contain particulars regarding size and routes of the conduits and trunking number of wires carried and the inspection and junction boxes provided along the routes of these conduits/trunking.

31.0 **MANUFACTURER’S INSTRUCTIONS**

Where manufacturers have furnished specific instructions, relating to the materials used in this job, covering points not specifically mentioned in these documents, these instructions shall be followed in all cases.

32.0 **MATERIALS & EQUIPMENT**

All materials and equipment shall be ISI marked and shall be of the approved make and design. Unless otherwise called for, only the best quality of materials and equipment shall be used. The Contractor shall be responsible for the safe custody of all materials and shall insure as against theft, damage by fire, earth quake etc. A list of items of
materials and equipment, together with a sample of each shall be submitted to the 
Engineer-in-charge within 15 days of the award of the contract.

33.0 SCALE
Drawings shall be prepared to the scale as required for proper explanation and shall 
indicate the size and location of all equipments and accessories herein. The contractor 
shall obtain all dimensions preferably at the building (site of work) and check those 
plans for interference with the building structure and other equipment.

34.0 BROCHURES AND DATA
The contractor shall submit four copies of all brochures manufacturer’s description data 
and similar literature.

35.0 APPROVAL OF MATERIALS
All materials used on the works shall be new and of the best quality available, 
conforming to the relevant specifications and as per good engineering practice. Prior 
approval shall be obtained in writing from the Consultant/Engineer-in-charge for all 
materials proposed and when necessary, approved sample duly identified and labelled 
shall be deposited with the Consultant/Engineer-in-charge and shall be kept at site. List 
of approved make indicates make/manufacturer generally acceptable but final choice of 
make/manufacturer generally and material & models shall be with the Consultant/ 
Engineer-in-charge.

36.0 INSPECTION, TESTING AND INSPECTION CERTIFICATE.

a. Engineer-in-charge and authorised representative shall have at all reasonable 
times access to the Contractor’s premises or works and shall have the power at 
all reasonable time to inspect and examine the materials and workmanship 
during its manufacture or erection or if the part of works is being manufactured 
or assembled at other premises or works.

b. The Contractor shall arrange all the materials and labour required for inspection 
of equipment or for any testing to be carried out at his works or at site. Notice for 
such inspection/presence for testing shall be given to the Engineer-in-charge by 
the Contractor atleast fifteen (15) days in advance.

c. Not withstanding approval of tests or equipment by the Consultant/Engineer-in-
Charge the contractor shall be required to perform site tests and prove the 
correctness of ratings and performance of equipment/machinery and materials 
supplied and installed by the Contractor as per the contract specifications and 
conditions. Consultant/Engineer-in-charge shall reserve the right to reject any 
equipment/ machinery/ material should it, on tests after erection, be found not to 
comply with contract specifications. Consultant/ Engineer-in-charge shall have 
full power to order the material or work to be tested by an independent agency at 
the electrical Contractor’s expense in order to prove soundness & adequacy.

37.0 SCHEDULE & MANNER OF OPERATION
Time being the essence of this contract, Contractor shall be expected to furnish all 
labour & material in sufficient quantities at appropriate time, expedite and schedule the 
work to meet the Engineer-in-charge requirement and so manage the operations that 
the work shall be completed in time stated else where. In case of shut down of power 
supply required, Contractor shall coordinate with Engineer-in-charge and shall carry out 
essential works during the shut down period allowed by the Engineer-in-charge. In case 
Engineer-in-charge allow for such period during night or early morning hours, Contractor
shall make all provisions to avail such opportunity and shall not be entitled for any extra claims on such account. Contractor shall programme their work in such a way that items of work requiring presence of Engineer-in-charge are carried out between 10 AM & 5 PM on working days.

38.0 MATERIAL INSPECTION, EXAMINATION & TESTING

All materials and equipment shall be brand new. On arrival of the materials at site they shall be inspected and tested by the Engineer-in-Charge to ensure that the materials conform to the specifications and standards. The Engineer-in-Charge and his representatives shall at all reasonable time have free access to the contractor's/ manufacturers works. They shall have full powers to examine the materials and workmanship of the equipment at the contractor works or at any other place from where the material or equipment is obtained. The contractor shall give every facility to the Engineer-in-Charge and his representatives and necessary help for inspection, examination & testing of the materials. Test certificates of the manufacturer's shall be submitted by the Contractor for all major equipment before they are accepted by the Engineer-in-Charge. Acceptance of any material or equipment shall in no way relieve the Contractor of his responsibility for meeting the requirements of the contract.

39.0 APPROVAL OF ELECTRICAL WORK

a. Electrical work done under this contract shall be executed by licensed wire men under the supervision of licensed electrical supervisor as per requirements of the Indian Electricity act.

b. Contractor shall obtain the approval of all electrical installation done under this contract from the appropriate competent authority before the installation is commissioning.

c. All inspection fees or submission fees paid by the contractor shall be reimbursed by the Department on presentation of valid official receipts.

40.0 INSURANCE

All equipment, materials, machinery and installations as a whole shall be insured by the contractor until virtual completion and take over by the Department. Insurance policy should cover for all kinds of erection risks, fire, theft, or loss in transit. All workers and third party shall be insured in accordance with the Workmen Compensation Act in the event of an accident.

41.0 CONTRACTOR'S SUPERVISION ON THE WORKS

a. The contractor shall give all necessary personal superintendent during the execution of the works, and as long thereafter as the Engineer-in-Charge may consider may necessary until expiration of the Guarantee Period. The contractor shall also during the time the works are in progress, appoint a competent representative who shall constantly supervise the work at site.

b. The electrical work shall be executed in close coordination with the progress of building work.

c. Any damage to the building as a result of execution of Electrical work shall be responsibility of the electrical contractor. The damage so caused shall be made good by the contractor promptly at his own cost to the entire satisfaction of the Engineer-in-Charge.
42.0 DEFECTS LIABILITY PERIOD:

The Defects Liability period shall commence from the date of issue of the Virtual completion Certificate, and shall extend for a period of Twelve Months. The Contractor’s liability shall be to replace the defective parts, rectify/reconstruct the defective work that may develop because of his own Project of those of his subcontractor approved by the Department arising from faulty material or workmanship of for any other reason. If it is necessary for the Contractor to rectify/reconstruct any defective portions of the work under the contract, the provision of this condition shall apply to the portions of work so replace or without prejudice to any other rights which the Department may have against the Contractor in respect of such defects.

The Contractor shall bear the cost of such repairs/rectifications carried out on his behalf at site immediately. On expiry of the defect liability period the Department shall issue a final certificate indicating that the Contractor has completed his obligations under the contract.

43.0 COMPLETION DRAWINGS

On completion of the work and before issue of certificate of virtual completion, the Contractor shall submit to the Engineer-in-charge completion plan drawn to a scale in tracing cloth with ink indicating the following, alongwith three blue print copies of the same.

a) Run and size of conduits, inspection boxes, junction boxes and pull boxes.

b) Number and size of conductors in each conduit.

c) Location and rating of sockets and switches controlling the light and power outlets.

d) Location and details of Main LT Panels, sub distribution boards & Final Distribution Boards indicating the circuit number controlled by them.

e) Type of fitting viz fluorescent, brackets, bulkhead, fans, etc. including fixing arrangement / details.

f) A complete wiring diagram as installed and schematic drawings showing all connections for the complete electrical system.

g) Location of all earthing stations, route and size of all earthing conductors, manhole etc.

h) Fabrication drawings of Main L.T. Panels & Sub Distribution Boards.

i) Route of L.T. Cable & Sub-main wiring including termination.

44.0 PAYMENT TERMS

Unless otherwise specified in the additional conditions of the contract the payment shall be made as per the relevant clauses of form PWD 7/8 forming a part of the tender document.

Security deposit shall be deducted from each running bill and the final bill to the extent of 10% of the gross amount payable subject to the maximum limit specified. The earnest
money deposit shall be adjusted against this security deposit. The security deposit shall be released on the expiry of guarantee / maintenance period stipulated in the contract. However, the contractor can furnish a bank guarantee in the specified format from a schedule bank for the full value of the security deposit in which event no recovery shall be made toward security deposit from his bills. The bank guarantee shall be kept valid till the expiry of the above guarantee / maintenance period.
1.0 GENERIC

1.1 The Internal Electrical works shall be carried out in accordance with Indian Standard Code of Practice for Electrical Wiring Installation IS: 732-1989 and IS: 2274-1963. Electrical Installation work shall also be in conformity with National Electrical Code with up to date amendments. All Electrical work shall be carried out in accordance with the provision of Indian Electricity Act 1910 & Indian Electricity Rules 1956 amended up to date. The work shall also conform to Indian Standard Code of Practice for the type of work involved. It shall also be in conformity with regulations and requirements of the Local Electricity Supply Authority and Fire Insurance regulations so far as these become applicable to the installation. Electrical work shall be carried out as per following CPWD general Specifications for Electrical Works.

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1.2 Wherever this Tender Specifications call for a higher standard of material and or workmanship than those required by any of the above mentioned regulations and specifications then the particular specifications given here under shall take precedence over the said regulations and standards.

1.3 The work shall be executed and measured as per the dimensions given in the Bill of Quantities. Drawings, Designs, Specifications etc. The abbreviations used shall mean as under :-

- Inch (25.4mm)
- Foot (12 inches or 30.48 cms)
- Square Feet
- Square Metre.
- Cubic Feet.
- Cubic Metre.
- Kilograms (Equivalent to 1000 gms)
- Tonne (Equivalent to 1000 Kgs.)
- Numbers.
- Centimetre.
- Metre or Running Metre.
2.0 MAIN / SUB DISTRIBUTION BOARDS & METER BOARDS.

2.1 GENERAL
MDB / SDB & Meter Board shall be metal clad totally enclosed, rigid, floor mounting, air insulated, compartmentalized cubicle type Panel Board for use on 415 volts, three phases, 50 cycle system. Equipment shall be designed for operation in high ambient temperature and high humidity tropical atmospheric conditions.

2.2 STANDARDS
The equipment shall be designed to conform to the requirements of:

a) IS 8623 - Factory Built Assemblies of switchgear and controlgear.
b) IS 4237 - General requirements for switchgear and controlgear for voltage not exceeding 1000 volts.
c) IS 2147-Degrees of protection provided by enclosures for low voltage switchgear and controlgear.
d) IS 375 - Marking and arrangement of busbars.

2.2.1 Individual equipment housed in the MDB / SDB & Meter Boards shall conform to the following IS specifications:

b) Current Transformers - IS : 2705.
c) Indicating Instruments - IS : 1248.
d) Integrating Instruments - IS : 722.
e) HRC fuse links - IS : 13703 / IEC 269.

2.3 CONSTRUCTIONS
2.3.1 METER BOARD
Meter Board shall be metal clad totally enclosed, rigid, floor/wall mounting, air insulated, cubicle type for use on 415 volts, 3 phase, 50 cycle system and shall conform to IP-54 protection. The Meter Board shall be fabricated with a 2mm sheet steel suitable reinforce with either M.S. angles or rolled/folded sheet steel channels sections. Meter chamber shall be of 400mm x 600mm in dimension with separate cover and locking arrangement. All sheet steel work forming the exterior of meter board shall be smoothly finished leveled and free from flaws. The corner shall be rounded. Synthetic/Neoprene gasket shall be provided for each meter chamber. Main incoming MCCB and Busbars shall be in separate compartment. Cable alley shall be provided for housing wiring from Busbar chamber to individual meter chamber and for outgoing submain wiring originating from Meter chamber to each shop / office.

2.3.2 MAIN /SUB DISTRIBUTION BOARD
Main / Sub Distribution Boards shall be constructed only of materials capable of withstanding the mechanical, electrical and thermal stresses, as the effects of humidity, which are likely to be encountered in normal service.

Each vertical section shall comprise of:

a) A front framed structure of rolled/folded sheet steel channel section, of minimum 2mm thickness, rigidly bolted together. This structure shall house the components

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contributing to the major weight of the equipment, such as circuit breaker cassettes, fuse switch units, main horizontal busbars, vertical risers and other front mounted accessories.

b) The structure shall be mounted on a rigid base frame of folded sheet steel of minimum 2mm thickness and 100 mm height or 100 mm x 50mm x 5mm thick MS Channel. The design shall ensure that the weight of the components is adequately supported without deformation or loss of alignment during transit or during operation.

c) A side cable chamber in Main / Sub Distribution Boards for housing the cable end connections, and power/ control cable terminations. The design shall ensure generous availability of space for ease of installation and maintenance of cabling, and adequate safety for working in one vertical section without coming into accidental contact with live parts in an adjacent section.

d) A cover plate at the top of the vertical section, provided with a ventilating hood where necessary. Any aperture for ventilation shall be covered with a perforated sheet having less than 1 mm diameter perforations to prevent entry of vermin.

e) Front and rear doors fitted with dust excluding neoprene gaskets with fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors, generous overlap shall be assured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust.

f) All doors shall be lockable mounted lock.

g) Gland plate shall be 3mm thick.

2.3.3 The height of the Main / Sub Distribution Boards should not be more than 2000mm. The total depth of the panel should be adequate to cater to proper cabling space and should not be less than 400mm. Operating handle not higher than 1800mm and not lower than 300mm from bottom of MDB / SDB / Meter Board.

2.3.4 Doors and covers shall be of minimum 2mm thick sheet steel. Sheet steel shrouds and partitions shall be of minimum 2mm thickness. All sheet panels shall be smoothly finished, levelled and free from flaws. The corners should be rounded.

2.3.5 The apparatus and circuits in the panel board shall be so arranged as to facilitate their operation and maintenance and at the same time to ensure the necessary degree of safety.

2.3.6 Apparatus forming part of the Main / Sub Distribution Boards & Meter Boards shall have the following minimum clearances.

i. Between phases  -  32mm.
ii. Between phases and neutral -  26mm.
iii. Between phases and earth -  26mm.
iv. Between neutral and earth -  26mm.

2.3.7 When, for any reason, the above clearances are not available, suitable insulation shall be provided. Clearances shall be maintained during normal service conditions.

2.3.8 Creepage distances shall comply to those specified in relevant standards.

2.3.9 All insulating material used in the construction of the equipment shall be of non-hygroscopic material, duly treated to withstand the effects of the high humidity, high temperature tropical ambient service conditions.
2.3.10 Functional units such as circuit breakers and fuse switches shall be arranged in multi-tier formation, except that not more than two air circuit breakers shall be housed in a single vertical section. Cable entry for various feeders shall be from the rear / front. Panel board shall be suitable for termination of cable for incoming breakers.

2.3.11 Metallic/perforated barriers shall be provided within vertical sections and between adjacent sections to ensure prevention of accidental contact with:

i. Main busbars and vertical risers during operation, inspection or maintenance of functional units and front mounted accessories.

ii. Cable termination of one functional unit, when working on those of adjacent unit/units.

All doors/covers providing access to live power equipment/ circuits shall be provided with tool operated fasteners to prevent unauthorized access.

Provision shall also be made for permanently earthing the frames and other metal parts of the switchgear by two independent connections.

2.4 METAL TREATMENT AND FINISH.

All metal work used in the construction of the MDB / SDB & Meter Boards should have undergone a rigorous metal treatment process as follows.

i. Effective cleaning by hot alkaline degreasing solution followed by cold water rinsing to remove traces of alkaline solution.

ii. Picking in dilute sulphuric acid to remove oxide scales & rust formation, if any, followed by cold water rinsing to remove traces of acidic solution.

iii. A recognised phosphating process to facilitate durable coating of the paint on the metal surfaces and also to prevent the spread of rusting in the event of the paint film being mechanically damaged. This again, shall be followed by hot water rinsing to remove traces of phosphate solution.

iv. Passivating in de-oxalite solution to retain and augment the effects of phosphating.

v. Drying with compressed air in a dust free atmosphere.

vi. A finishing coat of powder coating of Siemens grey colour.

2.5 BUSBARS

2.5.1 The busbars shall be air insulated and made of high conductivity, high strength Aluminium complying with the requirement of grade 63401 WP.

2.5.2 The busbars shall be suitably braced with non-hygroscopic SMC supports to provide a through fault withstand capacity of maximum 50KA RMS symmetrical for one second and a peak short circuit with stand capacity of 105 KA.

2.5.3 The neutral as well as the earth bar should be capable of with standing the above level. Ridges shall be provided on the SMC supports to prevent tracking between adjacent busbars. Large clearances and creepage distance shall be provided on the busbar system to minimize the possibility of fault. The main phase busbars shall have continues current rating throughout the length of the Panel. The cross section of neutral busbars shall be same as that of the phase busbar for busbars of capacity

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upto 200 Amp; for higher capacities, the neutral busbar shall not be less than half (50%) the cross section of that of the phase busbars. Connections from the main busbars to functional circuits shall be so arranged and supported to withstand without any damage or deformation the thermal and dynamic stresses due to short circuit currents. Busbars shall be colour coded with PVC heat shrinkable sleeves. All connectors of bus bars to busbars & outgoing termination arrangement is to be in Stainless steel non magnetic grade nut & bolts.

2.5.4 Capacity of aluminium busbars shall be considered as 0.8 Amp per sq.mm of cross section area of the busbars.

2.6 MOULDED CASE CIRCUIT BREAKERS

2.6.1 GENERAL

Moulded Case Circuit Breakers shall be incorporated in MDB / SDB & Meter Boards wherever specified. MCCB’s shall conform to IS 13947-2 and/or IEC 947-2 in all respects. MCCB’s shall be suitable either for single phase AC 230 volts or three phase 415 volts. MCCB shall be with thermo magnetic release type. All MCCB of 250Amp and above rating shall have microprocessor released.

2.6.2 FRAME SIZES

The MCCB’s shall have the following frame sizes subject to meeting the fault level specified elsewhere.

i) Up to 100A rating .................. 100Amp frame.
ii) Above 100A to 200A ............. 200Amp frame.
iii) Above 200A to 250A ............. 250Amp frame.
iv) Above 250A to 400A ............. 400Amp frame.
v) Above 400A to 630A ............. 630Amp frame.

2.6.3 CONSTRUCTIONS

The MCCB cover and case shall be made of high strength heat treatment and flame retardant thermo-setting insulating material. Operating handle shall be of rotary type quick make/quick break, trip-free type. The operating handle for simultaneous operation and tripping of all the three phases.

Suitable fire arc extinguishing device shall be provided for each contact. Tripping unit shall be of thermomagnetic type provided in each pole and connected by a common trip bar such that tripping of any one pole operates all three poles to open simultaneously. MCCB shall be line load reversible type. MCCB’s shall be site adjustable thermal release (80% to 100%) of rated current. Device shall have IDMT characteristics for sustained overload and short circuits. MCCB shall be current limiting type MCCB shall be provided with rotary handle.

Contacts tips shall be made of suitable arc resistant, silver alloy for long electrical life. Terminals shall be of liberal design with adequate clearance.
2.6.4 RUPTURING CAPACITY.

The Moulded Case Circuit Breaker shall have a minimum fault breaking capacity (Ics) of not less than 25 KA RMS at 415 volts for MDB / SDB & Meter Boards and / or higher capacity as specified in individual panel item.

2.6.5 TESTING.

Test certificate of the MCCB as per relevant Indian Standards (IS) shall be furnished.

2.7 MEASURING INSTRUMENTS, FOR METERING.

GENERAL

Direct reading electrical instruments shall be in conformity with IS 1248. The accuracy of direct reading shall be 1.0 for voltmeter and 1.0 for ammeters. Other type of instruments shall have accuracy of 1.5. The errors due to variations in temperature shall be limited to a minimum. The meter shall be suitable for continuous operation between -10 degree Centigrade to + 50 degree Centigrade. All meters shall be of flush mounting type of 96mm square or circular pattern. The meter shall be enclosed in a dust tight housing. The housing shall be of steel or phenolic mould. The design and manufacture of the meters shall ensure the prevention of fogging of instruments glass. Instruments meters shall be sealed in such a way that access to the measuring element and to the accessories within the case shall not be possible without removal of the seal. The meters shall be provided with white dials and black scale markings.

The pointer shall be black in colour and shall have zero position adjustment device which could be operated from outside. The direction of deflection shall be from left to right.

Suitable selector switches shall be provided for all ammeters and voltmeters intended to be used on three phase supply.

The specifications herein after laid down shall also cover all the meters, instrument and protective devices required for the electrical work. The ratings type and quantity of meters, instruments and protective devices shall be as per the schedule of quantities.

2.8 DIGITAL AMMETERS

Ammeters shall be digital type 7 segment LED display. Ammeter shall be suitable for accuracy class 1.0 and burden 0.5 VA approx. The ammeters shall be capable of carrying sustained overloads during fault conditions without damage or loss of accuracy.

2.9 DIGITAL VOLTMETERS

Voltmeter shall be digital type 7 segment LED display. Voltmeter shall be suitable for accuracy class 1.0 and burden 0.5 VA approx. The range for 3 phase voltmeters shall be 0 to 500 volts. The voltmeter shall be provided with protection fuse of suitable capacity.
2.10 **CURRENT TRANSFORMERS**

2.10.1 Current transformers shall be in conformity with IS: 2705 (Part I, II & III) in all respects. All current transformers used for medium voltage applications shall be rated for 1kv. Current transformers shall have rated primary current, rated burden and class of accuracy as required. However, the rated secondary current shall be 5A unless otherwise specified. The acceptable minimum class of various applications shall be as given below:

- **Measuring**: Class 0.5 to 1.
- **Protection**: Class 5P10.

2.10.2 Current transformers shall be capable of withstanding without damage, magnetic and thermal stresses due to short circuit fault of 50KA on medium voltage system. Terminals of the current transformers shall be marked permanently for easy identification of poles. Separate CT shall be provided for measuring instruments and protection relays. Each C.T. shall be provided with rating plate.

2.10.3 Current transformers shall be mounted such that they are easily accessible for inspection, maintenance and replacement. The wiring for CT’s shall be copper conductor, PVC insulated wires with proper termination lugs and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

2.11 **MISCELLANEOUS**

Control switches shall be of the heavy-duty rotary type with escutcheon plates clearly marked to show the operating position. They shall be semi-flush mounting with only the front plate and operating handle projecting.

Indicating lamps shall be of the LED type, and with translucent lamps covers. Bulbs & lenses shall be easily replaced from the front.

Push buttons shall be on the momentary contact, push to actuate type fitted with self-reset contacts & provided with integral escutcheon plates marked with its functions.

2.12 **CABLE TERMINATIONS**

Cable entries and terminals shall be provided in the sub distribution boards to suit the number, type and size of aluminium conductor power cable and copper conductor control cable specified.

Provision shall be made for top or bottom entry of cables as required. Generous size of cabling chambers shall be provided, with the position of cable gland and terminals such that cables can be easily and safely terminated. Cable glands shall be double compression type, barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit.

Cable risers shall be adequately supported to withstand the effects of rated short circuit currents without damage and without causing secondary faults.

2.13 **CONTROL WIRING**

All control wirings shall be carried out with 1100/660V grade single core PVC cable conforming to IS 694/ IS 8130 having stranded copper conductors of minimum 1.5 sq.mm for potential circuits and 2.5 sq.mm for current transformer circuits. Wiring
shall be neatly bunched, adequately supported and properly routed to allow for easy access and maintenance. Wiring shall be identified by numbering ferrules at each end. All control fuses shall be mounted in front of the panel and shall be easily accessible.

2.14 TERMINAL BLOCKS
Terminal blocks shall be 500 Volts grade of the stud type. Insulating barriers shall be provided between adjacent terminals. Terminals block shall have a minimum current rating of 10 Amps and shall be shrouded. Provisions shall be made for label inscriptions.

2.15 LABELS
Labels shall be of anodized aluminium, with white engraving on block background. They shall be properly secured with fasteners.

2.16 TEST AT MANUFACTURES WORK
All routine tests specified is IS : 8623-1977 shall be carried out and test certificates submitted to the Engineer-in-Charge.

2.16.1 TESTING AND COMMISSIONING
Commissioning checks and tests shall be included all wiring checks and checking up of connections. Primary/secondary injection tests for the relays adjustment/setting shall be done before commissioning in addition to routine meggar test. Checks and tests shall include the following.

a) Operation checks and lubrication of all moving parts.
b) Interlocking function check.
c) Insulation test: When measured with 500V meggar, the insulation resistance shall not be less than 100 mega ohms.
d) Trip tests & protection gear test.

2.17 MINIATURE CIRCUIT BREAKER
The MCB’s shall be of the completely moulded design suitable for operation at 240/415 Volts 50 Hz system.

The MCB’s shall have a rupturing capacity of 10 KA.

The MCB’s shall have inverse time delayed thermal overload and instantaneous magnetic short circuit protection.

Type test certificates from independent authorities shall be furnished.

3.0 ELECTRIC POWER DISTRIBUTION AND WIRING
3.1 INTRODUCTION
The electric power will be received and distributed in a building, through following means:-

(i). Cabling and switchgears to receive power.

(ii). The building is divided into convenient number of parts, each part served by a rising mains system to distribute power vertically / horizontally.

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iii. Power flows from rising mains through tap – off box to floor main board to final DBs and then to wiring.

(iv). While rising main takes care of general lighting and power outlet load of the building, other loads like lifts, pump sets, AC plants, other motor loads are fed by independent cables of suitable capacity fed from properly designed essential / non-essential LT panels with suitably designed switchgear having necessary control and safely features.

(v). Therefore the distribution / wiring system essentially consists of provision of cables, switchgears, rising main, bus-ducting earthing, laying of pipes/ conduits etc. (in surface of recess) based on proper detailed designing to decide on various sizes/ capacities of these components and various controls and safeties involved, to provide an efficient, reliable, safe and adequate electrical. Distribution and wiring system,

(vi). A typical schematic diagram of power distribution of a building is enclosed. (See Fig. 3) of General specification for Electrical works Part I Internal -2005

3.2 SYSTEM OF DISTRIBUTION AND WIRING :

(i) The wiring shall be done from a distribution system through main and / or branch distribution boards. The system design and location of boards will be properly worked out.

(ii) Each main distribution board and branch distribution board shall be controlled by an incoming circuit breaker / linked switch with fuse. Each outgoing circuit shall be controlled by a circuit breaker / switch with fuse.

(iii) For non- residential buildings, as far as possible, DBs shall be separate for light and power.

(iv) Only MCCB / MCB / HRC fuse type DBs shall be used. Rewireable type fuses shall not be used.

(v) Three phase DBs shall not be used for final circuit distribution as far as possible.

(vi) ‘Power’ wiring shall be kept separate and distinct from light wiring, from the level of circuits, i.e. beyond the branch distribution boards. Conduits for Light / power wiring shall be separate.

(vii) Essential / non essential / UPS distribution each will have a completely independent and separate distribution system starting from the main, switchboard upto final wiring for each system. As for example, conduit carrying non-essential wiring shall not have essential of UPS wiring. Wiring for essential and UPS supply will have their own conduit system. No mixing of wiring is allowed.

(viii) Generally, no switchboard will have more than one source of incoming supply. More than one incoming supply will be allowed only at main board with proper safety and interlocking so that only one source can be switched on at a time.

(ix) Each MDB / DB/ Switch board will have reasonable spare outgoing way for future expansion.

(x) Balancing of 3 Phase circuit shall be done.

3.3 WIRING :

3.3.1 Sub-main & Circuit Wiring

a) Sub-main Wiring

Sub-main wiring shall mean the wiring from one main/ distribution switchboard to another.

b) Circuit Wiring
Circuit wiring shall mean the wiring from the distribution board to the 1st tapping point inside the switch box, from where point wiring starts.

3.3.2 Measurement of Sub-main and Circuit wiring.

(i). Circuit and sub-main wiring shall be measured on linear basis along the run of the wiring. The measurement shall include all lengths form end to end of conduit or channel as the case may be, exclusive of interconnections inside the switchboard etc. the increase on account of diversion or slackness shall not be included in the measurement.

(ii). The length of circuit wiring with two wires shall be measured from the distribution board to the nearest switch box from which the point wiring starts. Looping of switch boxes also will be counted towards circuit wiring measured along the length of conduit / channel.

(iii). When wires of different circuits are grouped in the single conduit / channel, the same shall be measured on linear basis depending on the actual number and sizes of wires run.

(iv). Protective (loop earthing) conductors, which are run along the circuit wiring and the sub-man wiring, shall be measured on linear basis and paid for separately.

(v). NOTE : Conduit carrying sub-main will not carry circuit / point wiring. Similarly conduit carrying circuit wiring will not carry sub-main / point wiring. Conduit carrying point wiring not carry sub-main / circuit wiring

3.3.3 Measurement of other wiring work :-

Except as specified above for point wiring, circuit wiring and sub-main wiring, other types of wiring shall be measured separately on linear basis along the run of wiring depending on the actual number and sizes of wires run.

3.4 POINT WIRING :-

3.4.1 Definition

A point (other than socket outlet point) shall include all work necessary in complete wiring to the following wiring to the following outlets form the controlling switch or MCB.

a) Ceiling rose or connector (in the case of point for ceiling / exhaust fan points, pre-wired light fittings and call bells).

b) Ceiling rose (in case pendant except stiff pendants).

c) Back plate (in case of stiff pendants).

d) Lamp holder (in case of goose neck type wall brackets, batten holders and fittings which are not pre-wired).

3.4.2 Scope :

Following shall be deemed to be included in point wiring.

a) Conduit / channel as the case may be, accessories for the same and wiring cables between the switch box and the point outlet, loop protective earthing of each fan / light fixtures.

b) All fixing accessories such as clips, screws, phil plug rawl plug etc. as required.

c) Metal or PVC switch boxes for control switches, regulators, socket etc. recessed or surface type, and phenolic laminated sheet covers over the same.

d) Outlet boxes, junction boxes, pull – through boxes etc, but excluding metal boxes if any, provided with switchboard for loose wires/ conduit terminations.
e) Any special block required for neatly housing the conductor in batten wiring system.

f) Control switch or MCB, as specified.

g) 3 pin or 6 pin socket, ceiling rose or connector as required. (2 pin and 5 pin socket outlet shall not be permitted).

h) Connections to ceiling rose, connector socket outlet, lamp holder, switch etc.

i) Bushed conduit or porcelain tubing where wiring cables pass through wall etc.

3.4.3 Measurement

**Point wiring (other than socket outlet points)**

Unless and otherwise specified, there shall be no linear measurement for point wiring for light points, fan points, exhaust fan point and call bell points. These shall be measured on unit basis by counting, ad classified as laid down in 3.4.4.

3.4.4 Classifications

Point measured under 3.4.3 on unit basis shall be classified as under according to the type of building.

a) Residential buildings :-
   i. Group ‘A’ for point wiring for type I, type II and type III residential quarters and hotels.
   ii. Group ‘B’ for point wiring for type IV and above type of residential quarters and brackets.

b) Non-residential buildings :-
   Group ‘C’ for all types of non-residential building such as offices, hospitals, laboratories, educational institutions, libraries etc.

c) For any other type of building :-
   The group under which the points are to be classified shall be decided by the concerned Chief Engineer (Elect.).

3.4.5 Point wiring for socket outlet points :-

a) The light (6A) point and power (16A) point wiring shall be measured on linear basis, from the respective tapping point of live cable, namely switchbox another socket outlet point, or the sub distribution board as the case may be, up to the socket outlet.

b) The metal / PVC box with cover, switch / MCB, socket outlet and another accessories shall be measured and paid as a separate item.

**Note** :- There shall normally be no ‘On the board” light plug point.

c) The power point outlet may be 16A /6A, six pin socket outlet, where so specified in the tender documents.

3.4.6 Group Control Point Wiring.

a) In the case of points with more than one point controlled by the same switch, such points shall be measured in parts i.e. (a) from the switch to the first point outlet as one point and classified according to 3.4.4, and (b) for the subsequent points, the distance from that outlet to the next one and so on, shall be treated as separate point (s) and classified according to 3.4.4.

b) No recovery shall be made for non-provision of more than one switch in such cases.
**Twin Control Light Point wiring:**

a) A light point controlled by two numbers of two way switches shall be measured as two points from the fitting to the switches on either side and classified according to 3.4.4.

b) No recovery shall be made for non-provision of more than one ceiling rose or connector in such cases.

**3.4.7 Multiple Controlled Call Bell Point wiring:**

a) In the case of call bell points with a single call bell outlet, controlled from more than one place, the point shall be measured in parts i.e. (a) from the call bell outlet to one of the nearest ceiling roses meant for connection to bell push, treated as one point and classified according to 3.4.4 and (b) from that ceiling rose to the next one and so on, shall be treated as separate point (s) and classified according to 3.4.4.

b) No recovery shall be made for non-provision of more than one ceiling rose or connector for connection to call bell in such cases.

**3.5 WIRING SYSTEM:**

a) Wiring shall be done only by the looping system. Phase / live conductors shall be looped at the switchbox. For point wiring, neutral wire /earth wire looping for the 1st point shall be done in the switch box; and neutral earth looping of subsequent points will be made from point outlet.

b) In wiring, on joints in wiring will be permitted anywhere, except in switchbox or point outlets, where jointing of wires will be allowed with use of suitable connector.

c) The wiring throughout the installation shall be such that there is no break in the neutral wire except in the form of linked switchgears.

d) Colour coding:

> Following colour coding shall be followed in wiring

<table>
<thead>
<tr>
<th>Phase</th>
<th>Red / Yellow / Blue (Three Phase Wiring)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Live</td>
<td>Red (Single Phase Wiring)</td>
</tr>
<tr>
<td>Neutral</td>
<td>Black</td>
</tr>
<tr>
<td>Earth</td>
<td>Yellow / Green</td>
</tr>
</tbody>
</table>

e) Termination of circuit into switchboard:

Circuit will consist of Phase / Nutral / Earth wire. Circuit will terminate in a switchboard (first taping point, where from point wiring starts) in following manners:

- Phase wire terminated in phase connector.
- Neutral wire terminated in neutral connector.
- Earth wire terminated in earth connector.
- The switchboard will have phase neutral and earth termination connector blocks to receive phase / neutral / earth wires. (See fig. 4)

**3.6 RUN OF WIRING:**

a) The type of wiring shall be specified in the tender documents namely, surface conduit / recessed conduit, steel / PVC channel.

b) Surface wiring shall run as far as possible along the walls and ceiling, so as to be easily accessible for inspection.
c) Above false ceiling, in no case, open wiring shall be allowed. Wiring will be done in recessed conduit or surface steel conduit.

d) In recessed conduit system, routes of conduit will be planned, so that various inspection boxes provided don’t present a shabby look. Such boxes provided 5mm above plaster level, and they can be covered with plaster of paris with marking of junction boxes.

e) Where number of electrical services like electrical wiring, telephone wiring, computer cabling, pass through corridors, it may be proper to plan such service with properly designed aluminum / PVC channels duly covered by a false ceiling, so that subsequently such service can be maintained and additional cables can be provided.

f) Generally conduits for wiring will not be taken in floor slabs. When it is unavoidable special precaution to be taken to provide floor channels with provision for safety and maintenance. Alternatively false flooring can be provided.

3.7 PASSING THROUGH WALL OR FLOORS :-

a) When wiring cables are to pass through a wall these shall be taken through a protection (Steel / PVC) pipe or porcelain tube of suitable size such that they pass through in a straight line without twist or cross in them on either they pass through in a straight line with twist or cross in them on either end of such holes. The ends of metallic pipe shall be neatly bushed with porcelain, PVC or other approved materials.

b) All floors openings for carrying any wiring shall be suitably sealed after installation.

3.8 JOINTS IN WIRING

a) No bare conductor in phase and / or neutral or twisted joints in phase, neutral, and / or protective conductors in wiring shall be permitted.

b) There shall be no joints in the through – runs of cables. If the length of final circuit of sub-main is more than the length of standard coil, thus necessitating a through joint, such joint shall be made by means of approved mechanical connectors in suitable junctions boxes.

c) Termination of multi-stranded conductors shall be done using suitable crimping type thimbles.

3.9 RATING OF OUTLETS (TO BE ADOPTED FOR DESIGN)

a) Incandescent lamps in residential and non-residential buildings shall be rated at 60W and 100W respectively.

b) Ceiling fans shall be rated at 60W. exhaust fans, fluorescent tubes, compact fluorescent tubes, HPMV lamps, HPSV lamps etc. shall be rated according to their capacity. control gear loses shall be also considered as applicable.

c) 6A and 16A socket outlets points shall be rated at 100W and 1000W respectively, unless the actual values of loads are specified.

3.10 CAPACITY OF CIRCUITS :-

a) Lighting circuit shall feed light / fan / call bell points. Each circuit shall not have more than 800Watt connected load or more than 10 Points. However in case of CFL points where load per point may be less, number of points may be suitably increased.

b) Power circuit in non-residential building will have only one outlet per circuit.

c) Each power circuit in residential building can feed following outlets :
   - Not more than 2 Nos. 16A outlets.
   - Not more than 3 Nos. 6A outlets.

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• Not more than 1 No. 16A and 2 No. 6A outlets.

d) Load more than 1KW shall be controlled by suitably rated MCB and cable size shall be decided as per calculations.

e) Power wiring with bus trunking; - It is permitted to meet large – scale power requirement in a hall, or floor, with use of single phase or 3 phase bus bar running inside a metal enclosure. This will be provided with careful design and use of factory fabricated bus-trunking of reputed make, conforming to relevant BIS standards and with standard accessories link end feed unit, tap off with necessary safety features like over current, and short circuit and earth fault protection. Such trunking will be of specified breaking KA raking.

3.11 SOCKET OUTLETS :-

d) Where specified, shutter type (interlocking type) of socket shall be used.

e) Every socket outlet shall be controlled by a switch or MCB, as specified. The control switch / MCB shall be connected on the ‘live’ side of the line.

f) 5A/6A and 15A /16A socket outlets shall be installed at the following positions, unless otherwise specified.

• Non –residential building – 23cm above floor level.
• Kitchen – 23cm above working platform and away from the likely positions of stove and sink
• Bathroom – No socket outlet is permitted for connecting a portable appliance thereto. MCB / IC switch may be provided above 2m for fixed appliances, and at least 1m away from shower.
• Rooms in residences – 23cm above floor level, or any other level in special cases as desired by the Engineer – in – Charge.

g) Unless and otherwise specified, the control switches for the 6A and 16A socket outlets shall be kept along with the socket outlets.

3.12 CABLES

a) Copper conductor cable only will be used for sub-main / circuit / point wiring.

b) Minimum size of wiring ;

<table>
<thead>
<tr>
<th>Type</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light wiring</td>
<td>1.5 sq.mm.</td>
</tr>
<tr>
<td>Power wiring</td>
<td>4.0 sq.mm.</td>
</tr>
<tr>
<td>Power circuit rated More than 1KW</td>
<td>Size as per calculation</td>
</tr>
</tbody>
</table>

c) Insulation : Copper conductor cable shall be PVC insulated, Fire retardant, low smoke (FRLS) type conforming to BIS specifications.

d) Multi-stranded : Cables are permitted to be used.
3.13 FLEXIBLE CABLE :-
   a) Conductor of flexible cables shall be of copper. The cross sectional area of conductor for flexible cable shall be as per design.
   b) Only 3 core flexible cables shall be used for connecting single – phase appliances.
   c) Unless the flexible cables are mechanically protected by armoured, or though rubber, or PVC sheathed, these shall not be used in workshops and other places where they are liable to mechanical damage.
   d) Flexible cable connection to bell push from ceiling rose shall be taken through steel conduit / metallic casing and capping.

3.14 WIRING ACCESSORIES :-
   a) Control switches for points :-
      • Control switches (single pole switch) carrying not more than 16A shall be modular type. The switch shall be ‘ON’ when the knob is down.
      • Modular type switches of reputed make along with matching mounting boxes, shall be used in non-residential buildings and residential quarters of all types. Modular type sockets, stepped type fan regulators shall be used. All such boxes switches and accessories shall be of same make of modular switch manufacturer.
      • It is recommended to provide double pole MCB in proper enclosure as power outlet for window type AC unit, geysers etc.
   b) Switch Boxes :
      • Switch box shall be hot dip galvanized, factory fabricated. Suitable in size for surface / recess mounting and suitable in size for accommodating the required number of switches and accessories (where required to be used for applications other then modular switches / sockets).
      • Switch box also can be of non – metallic material. The technical sanctioning authority will approve specified makes of reputed quality and specifications.
   c) Switchbox cover (for application other than modular type) :-
      Phenolic laminated sheets of approved shade shall be used for switch box covers. These shall be of 3mm thick synthetic phenolic resin bonded laminated sheets as base material and conforming to Grade P-I of IS : 20361974.
      
      Note : Specification for switch boxes is covered in the chapters on the various types of wiring.
   d) Ceiling rose : -
      • A ceiling rose shall not be used on a circuit, the voltage of which normally exceeds 250V.
      • Only one flexible cord shall be connected to a ceiling rose. Specially designed ceiling roses shall be used for multiple pendants.
      • A ceiling rose shall not embody fuse terminals as an integral part of it;
   e) Lamp Holders : -
      • Lamp holders may be batten, angle, pendant of bracket holder type as required. He holder shall be made of brass and shall be rigid enough to maintain shape on application of a nominal external pressure. There
should be sufficient threading for fixing the base to the lamp holder part so that they do not open out during attention to the lamp or shade.

- Lamp holder for use no bracket and the like shall have not less than 1.3cm nipple, and all those for use with flexible pendant shall be provided with cord grips.
- All lamp holders shall be provided with shade carriers.
- Where centre contact Edison Screw lamp holders are used, the outer or screw contact shall be connected to the ‘middle wire’ or the neutral conductor of the circuit.

f) **Fitting types:**

The types of fittings shall be as specified in the tender documents.

**Indoor type fittings:**

- Where conductors are required to be drawn through tube or channel leading to the fitting, the tube or channel must be free from sharp angles or projecting edge, and of such size as will enable them to be wired with the conductor used for the final circuit without removing the braiding or sheathing. As far as possible all such tubes or channels should be of sufficient size to permitted looping back.
- Wires used within pre-wired fittings shall be flexible with PVC insulation and 14/0.193 mm (minimum) copper conductors. The leads shall be terminated on built – in – terminal block, ceiling rose or connector as required.
- Fittings using discharge lamps shall be complete with power factor correction capacitors, either integrally or externally. An earth terminal with suitable marking shall be provided for each fitting of discharge lamps.
- Fittings shall be installed such that the lamp is at a height of 2.4m above floor level, unless otherwise directed by the Engineer – in – charge.
- Fittings made of CRCA shall be phosphatized and powder / epoxy painted. for coastal areas and humid area like toilets, kitchen, for prolonging the life of such fittings, corrosion free materials like engineering plastic, aluminium, stainless steel, etc. should be used.

**Outdoor type fittings:**

Outdoor fittings shall have suitable IP protection. It is preferable that street light fittings are of cast aluminium body of IP65, for reducing recurring maintenance cost and improved performance. Where required IP 66 fittings also can be provided for reducing maintenance frequency and cost.

Other fittings are not available with tested IP 65/54 protection, can be properly fabricated with weatherproof features, proper gasketing etc. as far as possible corrosion free material like cast aluminium, stainless steel, engineering plastics may be used for fabrication of such fittings, to prolong life such fittings. There should not be any exposed wiring in such outdoor fittings.

**3.15 ATTACHMENT OF FITTINGS AND ACCESSORIES : -**

a) **Conduit wiring system : -**

- All accessories like switches, socket outlets, call bell pushes and regulators shall be fixed in flush pattern inside the switch / regulator boxes.
Accessories like ceiling roses, brackets, batten holders etc. shall be fixed on outlet boxes. The fan regulators may also be fixed on outlet boxes, if so directed by Engineer – in – charge.

- Aluminium alloy or cadmium plated iron screws shall be used to fix the accessories to their bases.
- The switch box / regulator box shall normally be mounted with their bottom 1.25m form floor level, unless otherwise directed by the Engineer – in – charge / Architect / Electrical Consultants.

b) Fixing to wall and ceiling :-

- Wooden plug for fixing to wall / ceiling will not be allowed. Fixing will be done with the help or PVC sleeves / Rowel plugs / dash fasteners as required.
- Drilling of holes shall be done by drilling machines only. No manual drilling of hole will be allowed.

3.16 FANS, REGULATORS AND CLAMPS : -

a) Ceiling Fans :-

- Ceiling fans including their suspension shall conform to relevant Indian Standards.
- All ceiling fans shall be wired to ceiling roses or to special connector boxes, and suspended form hooks or shackles, with insulators between hooks and suspension rods. There shall be no joint in he suspension rod.
  
  i. For wooden or steel joists and beams, the suspension shall consist of GI flat of size not less than 40mm x 6mm, secured on the side of the joists or beam by means of two coach screws of size not less than 5cm for each flat. Where there is space above the beam, a through- bolt of size not less than 1.5cm dia, shall be placed above the beam the beam from which the flats are suspended. In the letter case, the flats shall be secured from movements by means of another bolts and nut at the bottom of the beam. A hook consisting of MS rod of size not less than 1.5cm. dia shall be inserted between the MS flat through oval holes on their sides. Alternatively, the flats may be bent inward to hold tightly between them by means of a bolt and nut, a hook of ‘S’ form.
  
  ii. In the case of ‘I’ beams, flats shall be shaped suitably to catch the flanges and shall be held together by means of a long bolt and nut.
  
  iii. For concrete roofs, a 12mm dia. MS rod in the shape of ‘U’ with their vertical legs bent horizontally at the top at least 19cm or either side and bound to the top reinforcement of the roof shall be used as shown in Fig. 5.
  
  iv. In buildings with concrete roofs having a low ceiling height, where the fan clamp mentioned under sub clause (v) above cannot be used, or wherever specified, recessed type fan clamp inside metallic box, as shown in Fig. 6 shall be used.
  
  v. Canopies on top suspension rod shall effectively hide the suspension.
  
  vi. The leading in wire shall be of nominal cross sectional area not less than 1.5 sq.mm. and shall be protected from abrasion.
  
  vii. Unless otherwise specified, all ceiling fans shall be hung 2.75m above the floor.
viii. In the case of measurement of extra down rod for ceiling fan including wring, the same shall be measured in units of 10cm. any length less than 5cm shall be ignored.

ix. The wiring of extra down rod shall be paid as supplying and drawing cable in existing conduit.

b) Exhaust Fans :-

- Exhaust fans shall conform to relevant Indian Standards.
- Exhaust fans shall be erected at the place indicated by the engineer – in – charge. For fixing an exhaust fan, a circular opening shall be provided in the wall to suit the size of the frame, which shall be fixed by means of rag bolts embedded in the wall. The holes shall be neat plastered to the original finish of the wall. The exhaust fans shall be connected to the exhaust fan point, which shall be wired as near to the opening as possible, by means of a flexible cord, care being taken to see that the blades rotate in the proper direction.
- Exhaust fans for installation in corrosive atmosphere, shall be painted with special PVC paint or chlorinated rubber paint.
- Installation of exhaust fan in kitchens, dark rooms and such other special location need careful consideration; any special provision needed shall be specified.

c) Regulators :-

The metallic body of regulators of ceiling fans / exhaust fans shall be connected to earth by the protective conductor.

3.17 MARKING OF SWITCHBOARD :-

(a) Schematic Diagram :- First a comprehensive schematic diagram for each building is to be prepared, starting from Main L.T. Panel, rising main, sub-main boards, DBs, etc. and the manner in which they are connected. This will include essential, non –essential and UPS system main sub-main cables shall be indicated

(b) Marking of each main Board :- Each main board Sub-main board shall be marked indicating rating of each incoming / outgoing switch and the details of loads / area it feeds. Detail / size of incoming and outgoing cable also shall be marked indicating from where the incoming cable has originated.

(c) Marking of Distribution Board :-Each Distribution board shall be marked indicating detail of incoming switch (Size of cable and from where it is fed) and marking of each outgoing MCB indicating the area it feeds. Suitable marking sticker will be suitably fixed to indicate such details.

(d) Marking of Power / Light DBs :-Power / Light DBs shall be marked ‘P’ and ‘L’ respectively.

(e) Marking for Non- essential / Essential / UPS / Switch board :- Each switchboard shall be marked essential / non-essential / UPS to indicate the nature of such switchboards.

(f) Marking of Main earthing terminal :- Main earthing terminals in main / sun-main switchboard shall be permanently marked, as ‘Safety Earth –don’t remove’.

4.0 METALLIC CONDUIT WIRING SYSTEM
4.1 SCOPE
This chapter covers the detailed requirements for wiring work in metallic conduits. This chapter covers both surface and recessed types of works.

4.2 APPLICATION
(i) Recessed conduit is suitable generally for all applications. Surface conduit work may be adopted in places like workshops, plant rooms, pump rooms, wiring above false ceiling / below false flooring, and at locations where recessed work may not be possible to be done. The types of work, viz. surface or recessed, shall be as specified in the respective works.

(ii) Flexile conduits may only be permitted for interconnections between switchgear, DBs and conduit terminations in wall.

4.3 MATERIAL

4.3.1 CONDUITS
(i) All rigid conduit pipes shall be of steel and be ISI marked. The wall thickness shall be not less than 1.6mm (16SWG) for conduits upto 32mm dia and not less than 2mm (14 SWG) for conduits above 32mm dia. These shall be solid drawn or reamed by welding, and finished with galvanized or stove enameled surface.

(ii) The maximum number of PVC insulated cables conforming to IS : 694-1990 that can be drawn in one conduit is given size wise in Table I, and the number of cables per conduit shall not be exceeded. Conduit size shall be selected accordingly in each run.

(iii) No steel conduit less than 20mm in diameter shall be used.

4.3.2 CONDUIT ACCESSORIES
(i) The conduit wiring system shall be complete in all respects, including their accessories.

(ii) All conduit accessories shall be of threaded type, and under no circumstances pin grip type of clamp grip type accessories shall be used.

(iii) Bends, couplers etc. shall be solid type in recessed type of works and may be solid or inspection type as required, in surface type of works.

(iv) A) Saddles or surface conduit work on wall shall not be less than 0.55mm (24 gauges) for conduits upto 25mm dia and not less than 0.9mm (20 gauges) for larger diameter. The corresponding widths shall be 19mm & 25mm.

B) The minimum width and the thickness of girder clips used for fixing conduits to steel joints, and clamps shall be as per the Table II (General Specification for Electrical works Part I – Internal 2005).

4.3.3 OUTLETS
(i) The switch box or regulator box shall be made of metal on all sides, except on the front. In the case of cast boxes, the wall thickness shall be at least 3mm and in case of welded mild steel sheet boxes, the wall thickness shall not be less than 1.2mm (18 Gauge) for boxes upto a size of 20cm x 30cm, and above this size 1.6mm (16 Gauge) thick MS boxes shall be used. The metallic boxes shall be duly painted with anticorrosive paint before erection as per chapter 15 of these Specifications.
(ii) A) Outlet boxes shall be of one of the size, covered in the Schedule of Rate (Elect.), Part – I Internal – 1994/2004.

B) Where a large number of control switches and / or fan regulators are required to be installed at one place, these shall be installed in more than one outlet box a adjacent to each other for ease of maintenance.

(iii) An earth terminal with stud and 2 metal washers and terminal block shall be provided in each MS box for termination of protective conductors and for connection to stock outlet/ metallic body of fan regulator etc.

(iv) A metal strip shall be welded / screwed, to the metal box as support if tumbler type of control switches, sockets and or fan regulators in flush pattern.

(v) Clear depth of the box shall not be less than 60mm and this shall be increased suitably to accommodate mounding of fan regulators in flush pattern.

(vi) The fan regulators can also be mounted on the switch box covers, if so stipulated in the tender specification, or if so directed by the Engineer – in – charge.

(vii) Except where otherwise stated, 3mm thick phenolic laminated sheet as per clause 3.14.c shall be fixed on the front with brass screws, or aluminium alloy/ cadmium plated iron screws as approved by the Engineer – in – Charge.

INSTALLATION

4.3.4 COMMON ASPECTS FOR RECESSED AND SURFACE CONDUIT WORKS.

(i) CONDUIT JOINTS

(a) The conduit work of each circuit of section shall be completed before the cables are drawn in.

(b) Conduit pipes shall be joined by means of screwed couplers and screwed accessories only. Threads on conduit pipes in all cases shall be between 13mm to 19mm long, sufficient to accommodate pipe to full threaded portion of couplers or accessories.

(c) Cut ends of conduit pipes shall have no sharp edges, nor any burrs left to avoid damage to the insulation of the conductors while pulling them through such pipes.

(d) The Engineer – in – charge, with a view to ensuring that the above provision has been carried out, may require that the separate lengths of conduit etc., after they have been prepared, shall be submitted for inspection before being fixed.

(e) No bare threaded portion of conduit pipe shall be allowed, unless such bare threaded portion is treated with anticorrosive preservative or covered with approved plastic compound.

(ii) BENDS IN CONDUITS

(a) All necessary bends in the system, including diversion, shall be done either by neatly bending the pipes without cracking with a bending radius of not less than 7.5cm, or alternatively, by inserting suitable solid or inspection type normal bends, elbows or similar fittings, or by fixing cast iron inspection boxes, whichever is most suitable.
(b) No length of conduit shall have more than the equivalent of four quarter bends from outlet to outlet.

(c) Conduit fittings shall be avoided as far as possible on conduit system exposed to weather. Where necessary, solid type fittings shall be used.

(iii) OUTLETS

(a) All outlets such as switches, wall sockets etc. may be either flush mounting type, or of surface mounting type, as specified in the Additional Specifications.

(b) All switches (except piano type switches), socket outlets and fan regulators shall be fixed on metal strips which shall be screwed / welded to the box. Piano type switches and accessories shall be fixed on the phenolic laminated sheet covers in flush pattern.

(iv) PAINTING AFTER ERECTION

After installation, all accessible surface of conduit pipes, fittings, switch and regulator boxes etc. shall be painted in compliance with the clauses under chapter 15- “Painting” of General Specification for Electrical works Part I – Internal 2005.

4.3.5 ADDITIONAL REQUIREMENTS FOR SURFACE CONDUIT WORK.

(i) PAINTING BEFORE ERECTION

The outer surface of conduit including all bends, unions, tees junction boxes etc. forming part of the conduit system, shall be adequately protected against rust when such system is exposed to weather, by being painted with 2 coats or red oxide paint applied before they are fixed.

(ii) FIXING CONDUIT ON SURFACE

(a) Conduit pipes shall be fixed by saddles, secured to suitable approved plugs with screws in an approved manner at an interval of not more than one meter, but no either side of the couplers or bends or similar fittings, saddles shall be fixed at a distance of 30 cm from the center of such fittings.

(b) Where conduit pipes are to be laid along the trusses, steel joists etc. the same shall be secured by means of saddles of girder clips or clamps as required by the Engineer – in – charge.

(c) In long distance straight run of conduit, inspection type couplers at reasonable intervals shall be provided, or running threads with couplers and jam nuts shall be provided.

(iii) FIXING OUTLET BOXES.

Only portion of the switch box shall be sunk in the wall, the other portion being projected out for suitable entry of conduit pipes into the box.

4.3.6 ADDITIONAL REQUIREMENTS FOR RECESSED CONDUIT WORK.

(i) MAKING CHASE

(a) The chase in the wall shall be neatly made of ample dimensions to permit the conduit to be fixed in the manner desired.
(b) In the case of building under construction, the conduits shall be buried in the wall before plastering, and shall be finished neatly after erection of conduit.

(c) In case of exposed brick / rubber masonry work, special, care shall be taken to fix the conduit and accessories in position along with the building work.

(ii) **FIXING CONDUITS IN CHASE**

(a) The conduit pipe shall be fixed by means of staples, J-hooks, or by means of saddles, not more than 60cm apart or by any other approved means of fixing.

(b) All threaded joints of conduit pipes shall be treated with some approved preservative compound to secure protection against rust.

(iii) **FIXING CONDUITS IN RCC WORK**

(a) The conduit pipes shall be laid in position and fixed to the steel reinforcement bars by steel binding wires before the concreting is done. The conduit pipe shall be fixed firmly to the steel reinforcement bars to avoid their dislocation during pouring of cement concrete and subsequent tamping of the same.

(b) Fixing of standard bends or elbows shall be avoided as far as practicable, and all curves shall be maintained by bending the conduit pipe itself with a long radius, which will permit easy drawing in of conductors.

(c) Location of inspection / junction boxes in RCC work should be identified by suitable means to avoid unnecessary chipping of the RCC slab subsequently to locate these boxes.

(iv) **FIXING INSPECTION BOXES.**

(a) Suitable inspection boxes to the minimum requirement shall be provided to permit inspection and to facilitate replacement of wires, if necessary.

(b) These shall be mounted flush with the wall or ceiling concrete. Minimum 65mm depth junction boxes shall be used in roof slabs and the depth of the boxes in other places shall be as per IS : 2667- 1988.

(c) Suitable ventilation holes shall be provided in the inspection box covers.

(v) **FIXING SWITCH BOXES AND ACCESSORIES**

Switch boxes shall be mounted flush with the wall. All outlets such as switches, socket outlet etc. shall be flush mounting type, unless otherwise specified in the additional specifications.

(vi) **FISH WIRE**

To facilitate subsequent drawing of wires in the conduit, GI fish wire of 1.6mm/1.2mm (16 /18SWF) shall be provided alongwith the laying of the recessed conduit.

(vii) **BUNCHING OF CABLES.**

(a) Cables carrying Direct Current may, if desired, be bunched whatever their polarity, but cables carrying alternating current, if installed in metal conduit shall always be bunched so that the outgoing and return cables are drawn onto the same conduit.
(b) Where the distribution is so for single phase loads only, conductors for these phases shall be drawn in one conduit.

(c) In case of three phase loads, separate conduits shall be run from the distribution boards to the load points, or outlets as the case may be.

4.3.7 EARTHING REQUIREMENTS

(i) The entire system of metallic conduit work, including the outlet boxes and other metallic accessories, shall be mechanically and electrically continuous by proper screwed joints, or by double check nuts at terminations. The conduit shall be continuous when passing through wall or floors.

(ii) A protective (loop earthing) conductor(s) shall be laid inside the conduit between the metallic switch boxes and distribution switch boards and terminated into proper earth lugs. Terminals. Only PVC insulated copper conductor cable of specified size, green- yellow in color shall be allowed. Such conductors will not run external to the conduits.

(iii) The protective conductors shall be terminated properly using earth stud, earth terminal block etc. as the case may be.

(iv) Gas or water pipe shall not be used as protective conductor (earth medium).

### TABLE – I

Maximum number of PVC insulated 650/1100 V grade aluminium/ Copper conductor cable conforming to IS : 694 – 1990, [Clause 4.2.1 (ii)]

<table>
<thead>
<tr>
<th>Nominal Cross-Sectional Area of conductor (Sq.mm)</th>
<th>20mm</th>
<th>25mm</th>
<th>32mm</th>
<th>38mm</th>
<th>51mm</th>
<th>64mm</th>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>4</td>
</tr>
</tbody>
</table>

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NOTE:
1. The above table shows the maximum capacity of conduits for a simultaneous drawing in of cables.
2. The columns headed ‘S’ apply to runs of conduits which have distance not exceeding 4.25m between draw in boxes and which do not deflect from the straight by an angle of more than 15 degrees. The columns headed ‘B’ apply to runs of conduit which deflect from the straight by an angle of more than 15 degrees.
3. Conduit sizes are the nominal external diameters.

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>SIZE OF CONDUIT</th>
<th>WIDTH</th>
<th>THICKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>20mm</td>
<td>19mm</td>
<td>0.9 mm (20 SWG)</td>
</tr>
<tr>
<td>(ii)</td>
<td>25mm</td>
<td>19mm</td>
<td>0.9 mm (20 SWG)</td>
</tr>
<tr>
<td>(iii)</td>
<td>32mm &amp; above</td>
<td>25mm</td>
<td>1.2 mm (18 SWG)</td>
</tr>
</tbody>
</table>

5.0 NON METALLIC CONDUIT WIRING SYSTEM

5.1 SCOPE
This chapter covers the detailed requirements for wiring work in non-metallic conduits. This chapter covers both surface and recessed types of works.

5.2 APPLICATION
5.2.1 Recessed conduit work is generally suitable for all applications. Surface conduit work may be adopted in place like workshops etc. and where recessed work may not be possible to be done. The type of work shall be as specified in individual works.
5.2.2 Flexible non–metallic conduits shall be suds only at terminations, wherever specified.
5.2.3 Special precautions
   a. If the pipes are liable to mechanical damages, they should be adequately protected.
   b. Non- metallic conduit shall not be used for the following applications :-
      i. In concealed / inaccessible places of combustible construction where ambient temperature exceeds 60° C.
      ii. In places where ambient temperature is less than 5° C.
      iii. For suspension of fluorescent fittings and other fixtures.
      iv. In areas exposed to sunlight.
5.3 MATERIAL

5.3.1 CONDUITS

(i) All non-metallic conduit pipes and accessories shall be of suitable material complying with IS 2509-1973 and IS : 3419-1989 for rigid conduits and IS : 9537 (Part-5) 2000 for flexible conduits. The interior of the conduit free from obstructions. The rigid conduit pipes shall be ISI marked.

(ii) The conduits shall be circular in cross-section. The conduits shall be designated by their nominal outside diameter. The dimensional details of rigid non-metallic conduits are given in Table –III (General Specification for Electrical works Part I – Internal 2005).

(iii) No non-metallic conduit less than 20mm in diameter shall be used.

(iv) Wiring capacity

The maximum number of PVC insulated aluminium / copper conductor cables of 650 /1100V grade conforming to IS 694-1990 that can be drawn in one conduit of various size given in Table – I under clause 4.2.1 (ii). Conduit shall be selected accordingly.

5.3.2 CONDUIT ACCESSORIES

(i) The conduit wiring system shall be completed in all respect including accessories.

(ii) Rigid conduit accessories shall be normally of grip type.

(iii) Flexible conduit accessories shall be of threaded type.

(iv) Bends, couplers etc. shall be solid type in recessed type of works and may be solid or inspection type as required in surface type of works.

(v) Saddle of fixing conduits shall be heavy gauge non-metallic type with base.

(vi) The minimum width and the thickness of the ordinary clips or girder clips shall be as per Table IV

(vii) For all sizes of conduit, the size of clamping rod shall be 4.5mm (7 SWG) diameter.

5.3.3 OUTLETS

(i) The switch box shall be made of either rigid PVC molding, or mild steel, or cast iron on all sides except at the front. The regulator boxes shall however be made only of mild steel of cast iron.

(ii) PVC boxes shall comply with the requirements laid down in IS : 14772-2000. these boxes shall be free from burrs, fins and internal roughness.

The thickness of the walls and base of PVC boxes shall not be less than 2mm. the clear depth of PVC boxes shall not be less than 60m.

(iii) The specifications for metallic boxes shall be as per requirements of clause 4.2.3.

(iv) 3mm thick phenolic laminated sheet covers for all types of boxes shall be as per requirements of clause 3.14.c.
5.4 INSTALLATION

5.4.1 COMMON ASPECTS FOR RECESSED AND SURFACE CONDUIT WORKS.

(i) The erection of conduits of each circuit shall be completed before the cables are drawn in.

(ii) CONDUIT JOINTS

(a.) All joints shall be cemented with approved cement. Damaged conduit pipes/ fittings shall not be used in the work. Cut ends of conduit pipes shall have neither sharp edges nor any burrs left to avoid damage to the insulation of conductors while pulling them through such pipes.

(b.) The Engineer – in – charge, with a view of ensuring that the above provision has been carried out, may require that the separate lengths of conduit etc. after they have been prepared shall be submitted for inspection before being fixed.

(iii) BENDS IN CONDUITS

i. All bends in the system may be formed either by bending the pipes by an approved method of heating, or by inserting suitable accessories such as bend, elbows of similar fittings, or by fixing non-metallic inspection boxes, whichever is most suitable. Where necessary, solid type fittings shall be used.

ii. Radius of bends in conduit pipes shall not be less than 7.5cm No. length of conduit shall have more the equivalent of four quarter bends from outlet to outlet.

iii. Care shall be taken while bending the pipes to ensure that the conduit pipe is not injured, and that the internal diameter is not effectively reduced.

(iv) OUTLETS

All switches, plugs, fan regulators etc. shall be fitted in flush pattern. The fan regulators can be mounted on the switch box covers, if so stipulated in the tender specifications, or if so directed by the Engineer – in – Charge.

(v) PAINTING AFTER INSTALLATIONS

(v) After installation, all accessible surface of metallic accessories shall be painted in compliance with the clauses under chapter 15- “Painting” (General Specification for Electrical works Part I – Internal 2005).

5.4.2 ADDITIONAL REQUIREMENTS FOR SURFACE CONDUIT WORK.

(i) Conduit pipes shall be fixed by heavy gauge non-metallic saddles with base, secured to suitable approved plugs with screws in an approved manner, at an interval of not more than 60cm, but no either side of couplers or bends or similar fittings, saddle shall be fixed at a closer distance from the center of such fittings. Slotted PVC saddle may also be used where the PVC pipe can be pushed in through the slots.

(ii) Where the conduit pipes are to be laid along the trusses, steel joists etc. the same shall be secured by means of saddles or girder clips as required by the Engineer –In – charge. Where it is not possible to use these for fixing, suitable clamps with bolts and nuts shall be used.

(iii) If the conduit pipes are liable to mechanical damage, they shall be adequately protected.

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5.4.3 ADDITIONAL REQUIREMENTS FOR RECESSED CONDUIT WORK.

(i) MAKING CHASE

a) The chase in the wall shall be neatly made of ample dimensions to permit the conduit to be fixed in the manner desired.

b) In the case of building under construction, the conduits shall be buried in the wall before plastering, and shall be finished neatly after erection of conduit.

c) In case of exposed brick / rubber masonry work, special, care shall be taken to fix the conduit and accessories in position along with the building work.

(ii) FIXING CONDUITS IN CHASE

(b) The conduit pipe shall be fixed by means of staples, or by means of non-metallic saddles placed, not more than 60cm apart or shall be fixed by any other approved means of fixing.

(c) At either side of the bends, saddles / staples shall be fixed at distance of 15cm from the centre of the bends.

(iii) ERECTION IN RCC WORK

(a) The conduit pipes shall be laid in position and fixed to the steel reinforcement bars by steel binding wires before the concreting is done. The conduit pipe shall be fixed firmly to the steel reinforcement bars to avoid their dislocation during pouring of cement concrete and subsequent tamping of the same.

(b) Fixing of standard bends or elbows shall be avoided as far as practicable, and all curves shall be maintained by bending the conduit pipe itself with a long radius, which will permit easy drawing in of conductors.

(c) Location of inspection / junction boxes in RCC work should be identified by suitable means to avoid unnecessary chipping of the RCC slab subsequently to locate these boxes.

(iv) FIXING INSPECTION BOXES.

(a) Suitable inspection boxes to the minimum requirement shall be provided to permit inspection and to facilitate replacement of wires, if necessary.

(b) These shall be mounted flush with the wall or ceiling concrete. Minimum 65mm depth junction boxes shall be used in roof slabs and the depth of the boxes in other places shall be as per IS : 2667-1988.

(c) Suitable ventilation holes shall be provided in the inspection box covers.

(v) FIXING SWITCH BOXES AND ACCESSORIES

Switch boxes shall be mounted flush with the wall. All outlets such as switches, socket outlet etc. shall be flush mounting type, unless otherwise specified in the additional specifications.

(vi) FISH WIRE

To facilitate subsequent drawing of wires in the conduit, GI fish wire of 1.6mm/1.2mm (16/18SWF) shall be provided alongwith the laying of the recessed conduit.
(vii) **BUNCHING OF CABLES**

For case of maintenance, cables carrying direct current or alternating current shall always be bunched so that the outgoing and return cables are drawn in the same conduits.

### 5.4.4 EARTHING REQUIREMENTS

(i) A protective (earth) conductor(s) shall be drawn inside the conduit in all distribution circuit to provide for earthing of non-current carrying metallic parts of the installation. These shall be terminated on the earth terminal in the switch boxes, and / or earth terminal blocks at the DBs.

(ii) Gas or water pipe shall not be used as protective conductor (earth medium).

#### TABLE – III

*Dimensional details of rigid non-metallic conduits*

[Clause 5.2.1 (ii)]

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Nominal Outside Diameter (in mm)</th>
<th>Maximum Outside Diameter (in mm)</th>
<th>Minimum inside Diameter (in mm)</th>
<th>Maximum Permissible eccentricity (in mm)</th>
<th>Maximum Permissible ovality (in mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>20</td>
<td>20 + 0.3</td>
<td>17.2</td>
<td>0.2</td>
<td>0.5</td>
</tr>
<tr>
<td>2.</td>
<td>25</td>
<td>25 + 0.3</td>
<td>21.6</td>
<td>0.2</td>
<td>0.5</td>
</tr>
<tr>
<td>3.</td>
<td>32</td>
<td>32 + 0.3</td>
<td>28.2</td>
<td>0.2</td>
<td>0.5</td>
</tr>
<tr>
<td>4.</td>
<td>40</td>
<td>40 + 0.3</td>
<td>35.8</td>
<td>0.2</td>
<td>0.5</td>
</tr>
<tr>
<td>5.</td>
<td>50</td>
<td>50 + 0.3</td>
<td>45.0</td>
<td>0.4</td>
<td>0.6</td>
</tr>
</tbody>
</table>

#### TABLE – IV

*ORDINARY CLIPS OR GIRDER CLIPS*

[Clause 5.2.2 (vi)]

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>SIZE OF CONDUIT</th>
<th>WIDTH</th>
<th>THICKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>20mm &amp; 25mm</td>
<td>19mm</td>
<td>0.9144 mm (20 SWG)</td>
</tr>
<tr>
<td>(ii)</td>
<td>32mm &amp; above</td>
<td>25mm</td>
<td>1.219 mm (18 SWG)</td>
</tr>
</tbody>
</table>

### 6.0 DISTRIBUTION BOARDS.

#### 6.1

Distribution boards for final distribution for lighting & small power shall be provided under Internal Electrical Works.

#### 6.2

Distribution Board shall be double door type with extended loose wire box at the top and suitable for flush installation. All distribution boards shall be of three phase (415 Volts) or single-phase (240Volts) type with incoming isolator or MCB and/or ELCB as in bill of quantities. Distribution boards shall contain plug in or bolted type miniature circuit breaker mounted on busbars. Miniature circuit breakers shall be quick make &
quick break type with trip free mechanism. MCB shall have thermal & magnetic short
circuit protection. MCB shall conform with IS 8828-1978. Busbars shall be of
electrolytic copper. Neutral busbars shall be provided with the same number of
terminals, as there are single ways on the board, in addition to the terminals for
incoming mains. An earth bar of similar size as the neutral bar shall also be provided.
Phase barrier shall be fitted and all live parts shall be screened from the front. Ample
clearance shall be provided between all live metal and the earth case and adequate
space for all incoming and outgoing cables. All distribution board enclosures shall
have an etched zinc base stove painted followed by synthetic stoved enamel, colour
light gray. A circuit identification card in clear plastic cover shall be provided for each
distribution board.

6.3 Distribution Board with single-phase outgoings requirement shall be Horizontal type.
Distribution Board with three-phase outgoings requirement shall be Vertical/
Horizontal type. Distribution Board installed in indoor dry locations shall conform to
IP-42. Distribution Board installed in outdoor & wet locations shall conform to IP-65.

6.4 Miniature Circuit Breakers for lighting circuits shall be of "B" series where as the
circuits feeding discharge lamps (HPMV/HPSV/Metal Halide) halogen lamps, all
power outlet points, equipment/ machinery shall be of "C/D" series (Motor circuit)
types. All miniature circuit breakers shall be of not less than 10 KA rated rupturing
capacity.

6.5 Distribution Board shall be provided with isolator or MCB and/or Residual Current
Circuit Breaker as mentioned in drawings and BOQ. Residual Current Circuit Breaker
shall be current operated type and of 30mA sensitivity unless otherwise stated. RCCB
shall be mounted within distribution board box for single phase distribution board while
in three phase distribution board RCCB shall be either mounted within distribution
board box or in a separate MS box below distribution board. Width and depth of
RCCB box shall be same as that of distribution board box and of same finish. Height
of RCCB box shall be sufficient to accommodate RCCB & termination of incoming &
outgoing wires. Distribution board box, isolator, MCB’S used shall be of one/same
manufacturer. Standard size manufactured by approved manufacturer shall be used.
In case size specified in BOQ is not standard size of manufacturer, in that case next
standard size distribution board box shall be used with incoming & outgoing MCB as
specified in BOQ. Additional cutout/space for outgoing MCB shall be plugged with
blank plates. No extra cost shall be paid for using bigger/higher size distribution board
box and blank plates.

7.0 L.T CABLES

7.1 GENERAL

L.T. Cables shall be supplied, inspected, laid tested and commissioned in accordance
with drawings, specifications, relevant Indian Standards specifications and cable
manufacturer’s instructions. The cable shall be delivered at site in original drums with
manufacturer’s name clearly written on the drums. The recommendations of the cable
manufacturer with regard to jointing and sealing shall be strictly followed.

7.2 MATERIALS

The L.T. Power cables shall be XLPE insulated PVC sheathed type aluminium
conductor armoured cable conforming to IS : 7098 : 1988 (Part-I) with upto date
amendments where as control cable shall be XLPE insulated and PVC sheathed copper conductor armoured/ unarmoured cable conforming to IS:7098 (Part-I) 1988.

7.3 **INSTALLATION OF CABLES**

Cables shall be laid directly in ground, pipes, masonry ducts, on cable tray, surface of wall/ceiling etc. as indicated on drawings and/or as per the direction of Engineer-In-Charge. Cable laying shall be carried out as per CPWD specifications.

7.4 **INSPECTION**

All cables shall be inspected at site and checked for any damage during transit.

7.5 **JOINTS IN CABLES**

The Contractor shall take care to see that the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilisation and avoiding of cable joints. This apportioning shall be got approved from Engineer-In-Charge before the cables are cut to lengths.

7.6 **LAYING CABLES IN GROUND**

Cables shall be laid by skilled experienced workmen using adequate rollers to minimize stretching of the cables. The cable drums shall be placed on jacks before unwinding the cable. With great care it shall be unrolled on over wooden rollers placed in trenches at intervals not exceeding 2 metres. Cables shall be laid at depth of 0.75 metres below ground level. A cushion of sand total of 250mm shall be provided both above and below the cable, joint boxes and other accessories. Cable shall not be laid in the same trench or along side a water main.

The cable shall be laid in excavated trench over 80mm layer of sand cushion. The relative position of the cables, laid in the same trench shall preserved. At all changes in direction in horizontal and vertical planes, the cables shall be bent smooth with a radius of bent not less than 12 times the diameter of cables. Minimum 3 metre long loop shall be provided at both end of cable.

Distinguishing marks may be made on the cable ends for identifications of phases. Insulation tapes of appropriate voltage and in red, yellow and blue colours shall be wrapped just below the sockets for phase identifications.

7.7 **PROTECTION OF CABLES**

The cables shall be protected by bricks laid on the top layer of the sand for the full length of underground cable. Where more than one cables is laid in the same trench, the bricks shall cover all the cables and shall project a minimum of approximately 80mm on either side of the cables. Cable under road crossings and any other places subject to heavy traffic, shall be protected by running them through Hume Pipes of suitable size.

7.8 **EXCAVATION & BACK FILL**

All excavation and back fill required for the installation of the cables shall be carried out by the Contractor in accordance with the drawings and requirements laid down elsewhere. Trenches shall be dug true to line and grades. Back fill for trenches shall be filled in layer not exceeding 150mm. Each layer shall be properly rammed and consolidated before laying the next layer.
The Contractor shall restore all surface, roadways, side walks, kerbs wall or the works cut by excavation to their original condition to the satisfaction of the Engineer-In-Charge.

7.9 **LAYING OF CABLES ON CABLE TRAY/SURFACE OF WALL/CEILING**

Cable shall be laid on perforated M.S. Cable tray. Cables shall be properly dressed before cable ties/clamps are fixed. Wherever cable tray is not proposed, cables shall be fixed on surface of wall or ceiling slab by suitable MS clamps/ saddles. Care shall be taken to avoid crossing of cable.

7.10 **CABLES ON HANGERS OR RACKS**

The Contractor shall provide and install all iron hangers racks or racks with die cast cleats with all fixings, rag bolts or girder clamps or other specialist fixing as required.

Where hangers or racks are to be fixed to wall sides, ceiling and other concrete structures, the Contractor shall be responsible for cutting away, fixing and grouting in rag bolts and making good.

The hangers or racks shall be designed to leave at least 25mm clearance between the cables and the face to which it is fixed. Multiple hangers shall have two or more fixing holes. All cables shall be saddled at not more than 150mm centres. These shall be designed to keep provision of some spare capacity for future development.

7.11 **CABLES TAGS**

Cable tags shall be made out of 2mm thick aluminium sheets, each tag 1-1/2 inch in dia with one hole of 2.5mm dia, 6mm below the periphery. Cable designations are to be punched with letter/number punches and the tags are to be tied inside the panels beyond the glanding as well as below the glands at cable entries. Trays tags are to be tied at all bends. On straight lengths, tags shall be provided at every 5 metres.

7.12 **TESTING OF CABLES**

Prior to installation, burying of cables, following tests shall be carried out. Insulation test between phases, phase & neutral, phase & earth for each length of cable.

a. Before laying.

b. After laying.

c. After jointing.

On completion of cable laying work, the following tests shall be conducted in the presence of the Engineer-In-Charge.

a. Insulation Resistance Test (Sectional and overall).

b. Continuity Resistance Test.

c. Earth Test.

All tests shall be carried out in accordance with relevant Indian Standard code of practice and Indian Electricity Rules. The Contractor shall provide necessary instruments, equipments and labour for conducting the above tests & shall bear all expenses of conducting such tests.
8.0 CABLE TRAY

8.1 PERFORATED TYPE CABLE TRAY

The cable tray shall be fabricated out of slotted/perforated MS sheets as channel sections, single or double bended. The channel sections shall be supplied in convenient lengths and assembled at site to the desired lengths. These may be galvanised or painted as specified.

Typically, the dimensions, fabrication details etc. are shown in CPWD General Specification for Electrical Works Part-II-External: 1994.

The jointing between the sections shall be made with coupler plates of the same material and thickness as the channel section. Two coupler plates, each of minimum 200mm length, shall be bolted on each of the two sides of the channel section with 8mm dia round headed bolts, nuts and washers. In order to maintain proper earth continuity bond, the paint on the contact surface between the coupler plates and cable tray shall be scraped and removed before the installation.

The maximum permissible uniformly distributed load for various sizes of cable trays and for different supported span are as per Table-IV of CPWD General Specifications of Electrical Works Part II(External) : 1994. The sizes shall be specified considering the same.

Factory fabricated bends, reducers, tee/cross junctions, etc. shall be provided as per good engineering practice. (Details are typically shown in figure-3) of CPWD General Specifications of Electrical Work Part-II – 1994. The radius of bends, junctions etc. shall not be less than the minimum permissible radius of bending of the largest size of cable to be carried by the cable tray.

The entire tray (except in the case of galvanised type) and the suspenders shall be painted with two coats of red oxide primer paint after removing the dirt and rust, and finished with two coats of spray paint of approved make synthetic enamel paint.

8.2 LADDER TYPE CABLE TRAY

Ladder type cable tray shall be fabricated out of double bended channel section longitudinal members with single bended channel section rungs of cross members welded to the base of the longitudinal members at a centre to centre spacing of 250mm. The channel sections shall be supplied in convenient lengths and assembled at side to the desired lengths. These may be galvanised or painted to the desired lengths. Alternatively, where specified, the cable tray may be fabricated by two angle irons of 50mm x 50mm x 6mm as two longitudinal members, with crosses bracings between them by 50mm x 5mm flats welded/bolted to the angles at 1 m spacing.

Typically, the dimensions, fabrication details etc. are shown in CPWD General Specification for Electrical Works - Part II -External, 1994.

The jointing between the sections shall be made with coupler plates of the same material and thickness as the channel section. Two coupler plates, each of minimum 200mm length, shall be bolted on each of the two sides of the channel section with 8mm dia round headed bolts, nuts and washers. In order to maintain proper earth continuity bond, the paint on the contact surfaces between the coupler plates and cable tray shall be scraped and removed before the installation.
The maximum permissible uniformly distributed load for various sizes of cable trays and for different supported span are as per CPWD General Specification of Electrical Work Part II -1994. The sizes shall be specified considering the same.

The width of the cable tray shall be chosen so as to accommodate all the cable in one tier, plus 30 to 50% additional width for future expansion. This additional width shall be minimum 100mm. The overall width of one cable tray shall be limited to 900mm.

Factory fabricated bends, reducers, tee/cross junctions, etc. shall be provided as per good engineering practice. Details are typically shown in figure 3 of CPWD General Specification of Electrical Work Part-II-1994. The radius of bends, junctions etc. shall not be less than the minimum permissible radius of bending of the largest size of cable to be carried by the cable tray.

The entire tray (except in the case of galvanised type) and the suspenders shall be painted with two coats of red oxide primer paint after removing the dirt and rust, and finished with two coats of spray paint of approved make synthetic enamel paint.

The cable tray shall be bonded to the earth Terminal of the switch bonds at both ends.

The cable trays shall be measured on unit length basis, along the center line of the cable tray, including bends, reducers, tees, cross joints, etc, and paid for accordingly.

The cable tray shall be suspended from the ceiling slab with the help of 10mm dia MS rounds or 25mm x 5mm flats at specified spacing as per of CPWD General Specification of Electrical Work Part II -1994. Flat type suspenders may be used for channels upto 450mm width bolted to cable trays. Round suspenders shall be threaded and bolted to the cable trays or to independent support angles 50mm x 50mm x 5mm at the bottom end as specified. These shall be grouted to the ceiling slab at the other end through an effective means, as approved by the Engineer, to take the weight of the cable tray with the cables.

9.0 CONDUITING FOR TELEPHONE / FDA SYSTEM & WIRING FOR TELEPHONE OUTLET

9.1 GENERAL
Contractor shall supply & install conduit for outlet points for Telephone & FDA System complete as required fish wire shall be provided in all conduits for facilitate wiring at later stage.

9.2 CONDUITING
Conduiting shall be carried out in PVC Conduit. Separate conduit shall be provided for Telephone. Conduiting for FDA system shall be in M.S. conduit. Conduiting shall be carried out as per clause No. 4.0 & 5.0 of this specification.

9.3 TELEPHONE WIRING
Each telephone outlet shall be wired in conduit with 0.50 mm dia annealed tinned copper conductor PVC insulated and PVC sheathed unarmoured cable from floor-wise Telephone Tag Block. Main Telephone tag block shall be fixed on ground floor. Floorwise tag block shall be wired from Main telephone tag block with multi-paired armoured 0.50 mm dia annealed copper conductor PVC insulated & PVC sheathed cables.
9.4 OUTLETS
All outlet boxes shall be modular plate type accessories. Cover plate shall match in shape & finish with other light and power accessories. For telephone outlet RJ-11 Jack outlets shall be provided. For Data Networking & FDA, only outlet box shall be provided. Modular cover plate & socket shall be covered under respective subhead of Data Networking & FDA system.

9.5 TELEPHONE DISTRIBUTION BOARD
Telephone Tag Block shall be fabricated from 1.63 mm thick M.S. Sheet duly powder coated after metal treatment. Telephone Distribution Board shall be equipped with krone type tag block of size as mentioned in BOQ. Tag block shall be double jumpering type and shall be suitable for termination of extra pair provided in wiring/cabling of each outlet. Box shall have hinged cover and finish shall match with aesthetic finish of the building.

9.6 JUNCTION BOXES FOR FDA / TELEPHONE SYSTEM
Conduiting of outlet points shall terminate in a junction box in respective area. Junction box shall be sufficient dimension or as per dimension in BOQ to accommodate all the conduits. Junction box shall be of sheet steel of minimum 1.63mm thick and cover shall be of 3mm thick phenolic laminated sheet fixed to junction box with brass screws.

10.0 LIGHTNING PROTECTION SYSTEM
The contractor shall supply and install a complete Lightning Protection System in accordance with CPWD General specification for Electrical Works (Part I-Internal) -2005 and IS 2309-1989.

The system shall consist of fixing of 20mm x 3mm galvanized iron strip on parapet wall as horizontal conductor. Vertical drops shall be also of 20mm x 3mm G.I. strip fixed to surface of the wall. Conductors shall be securely attached to the building and shall be of galvanized steel with suitable precautions to avoid corrosion. Steel thoroughly protected against corrosion by a zinc coating shall be used. The lightning conductor shall be secured at not more than 1.2 metre apart for horizontal run and 1 metre apart for vertical run.

Each vertical Down Conductor shall be provided with test joint clamp which shall be located 1 metre above outside ground level. From test joint 32mm x 6mm thick G.I. strip shall be fixed/laid up to earth electrode. Care shall be taken to have as few joints as possible in the system. No joint shall be permitted below ground level. All joints shall be mechanically and electrically effective.

Each vertical down conductor shall be connected to independent earth electrode. Earth electrode shall be 600mm x 600mm x 6mm G.I. plate. Earth electrode shall be installed as described in earthing specifications. The whole of the Lightning Protection System shall have a combined resistance to earth not exceeding 10 ohms. Earthing shall be carried out as described under "Earthing" section.

11.0 EARTHING

11.1 GENERAL
All the non-current metal parts of electrical installation shall earthed properly. All metal conduits, Distribution boards, switch boxes, outlet boxes, and all other parts made of
metal shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system. Earthing work shall conform to Indian Standard specification IS: 3043-1987 and relevant Indian Electricity Rules 1956 amended upto date.

11.2 **EARTHING CONDUCTOR**

Earthing conductor shall be of GI or copper and shall be protected against mechanical injury or corrosion. Earth continuity conductor from distribution board onward upto outlet point shall be of insulated copper conductor. Earth continuity conductor alongwith sub main from Main / Sub Distribution Board to final Distribution Board shall be insulated copper conductor.

Earthing continuity conductor between Sub Distribution Board shall be 25 x 5mm GI strip. For UPS Earthing, earth continuity conductor shall be of copper.

11.3 **SIZING OF EARTHING CONDUCTOR**

Earthing conductor shall be of GI or copper and shall be protected against mechanical injury or corrosion. Earth continuity conductor from distribution board onward upto outlet point shall be of insulated copper conductor while earth continuity conductor from Sub Distribution Board / Rising Mains upto final distribution board (lighting & power) shall be of insulated copper wire. For 3 phase distribution boards / outlets shall have 2 earth continuity conductors while single phase distribution boards outlets shall have one earth continuity conductor.

All 6Amp & 16Amp outlet points, switch boxes shall be earthed with 2.5 Sq.mm PVC insulated (Green) copper wire. All outlets above 16Amp shall be provided with 4 sq.mm. PVC insulated (Green) copper earth wire. Separate earth wire shall be drawn alongwith each circuit. Each light / fan points shall be provided with 1.5 sqmm. PVC insulated (Green) copper earth wire. Each circuit shall have separate earth wire.

11.4 **PLATE EARTH ELECTRODE**

Earthing shall be provided with copper/G.I plate electrode of following.

i.  Copper Plate Electrode: 600mm x 600mm x 3mm thick

ii. G.I plate Electrode: 600mm x 600mm x 6mm thick

The electrode shall be buried in ground with its faces vertical and not less 4.5metres below ground level. 20mm dia medium class GI pipe shall be provided and attached to the electrode.

A funnel with mesh shall be provided on the top of this pipe for watering and earth electrode. Earth electrode the watering funnel attachment shall be housed in masonry enclosure of not less than 300 x 300 x 300mm deep. A precast RCC frame with cover shall be provided at top of chamber. Earth electrode may not effect the column footing or foundation of the building. In such cases electrode may be further away from the building.

11.5 **PIPE EARTH ELECTRODE**

GI pipe shall be of medium class 40mm dia and 4.5 metre in length. Galvanishing of the pipe shall conform to relevant Indian Standards. GI pipe electrode shall be cut tapered at the bottom and provided with holes of 12mm dia drilled not less than 7.5cm
from each other upto 2 metre of length from bottom. The electrode shall be burried in
the ground vertical with its top not less than 20cm below ground level as per detail
enclosed. Earth electrode shall not be situated less than 2 metres from the building.
The location of the earth electrode will be such that the soil has reasonable chance of
remaining moist as far as possible. Masonary chamber of size 300 x 300 x 300 mm
shall be provided with water funnel arrangement a cast iron or MS frame & cover
having locking arrangement at the top. Pipe earth electrode shall be used for earthing
of Feeder pillar & external lighting poles.

11.6 ARTIFICIAL TREATMENT OF SOIL
If the earth resistance is too high and the multiple electrode earthing does not give
adequate low resistance to earth, then the soil receptivity immediately surrounding
the earth electrodes shall be reduced by addition of sodium chloride, calcium chloride,
sodium carbonates copper sulphate, salt and soft coke or charcoal in suitable
proportions.

11.7 RESISTANCE TO EARTH
The resistance of earthing system shall not exceed 1 ohm.

12.0 INSTALLATION OF LIGHT FIXTURES
12.1 SUPPORTS AND FIXINGS
12.1.1 Where fluorescent luminaires 1200 mm or more in length are supported directly by the
conduit system they shall be fixed to two circular conduit boxes both of which shall form
an integral part of the conduit system.
12.1.2 Where the weight of the luminaire is supported by a conduit box or cable trunking the
fixing of the conduit box or trunking shall be adequate for the purpose and approved by
Architect/Consultant.
12.1.3 Luminaires fitted with tungsten filament, lamps and having metal backplates shall not be
fixed directly to conduit box in which a thermoplastic material is the principal
load-bearing member.
12.1.4 Support of luminaires from cable trunking shall be by means of appropriate clamps or
brackets.
12.1.5 Luminaires mounted on or recessed into suspended ceilings shall not be support on the
false ceiling unless specifically shown and approved.
12.1.6 For wall mounted luminaires, the mounting height specified on drawings shall be above
finished floor level measured to the centre of the conduit box, unless otherwise
indicated.

12.2 WIRING CONNECTIONS
12.2.1 Where luminaires, other than those are fixed direct to circular boxes or supported by
pendants or chains, the final circuit wiring shall terminate at a terminal block in the conduit
box.
12.2.2 Where luminaires having fluorescent tubes are fixed direct to circular conduit boxes, the
final circuit wiring may be terminated within the Inuinaire unless otherwise indicated. The
wiring shall enter each luminaire at the conduit entry nearest to the terminal block and
where the loop - in wiring system is used leave by same entry wiring shall not pass
through a luminaire.
12.2.3 Where luminaires are mounted on or recessed into a suspended ceiling connection shall be
by flexible cord from a plug in ceiling rose shall be located not more than 500 mm
from the access panel in the ceiling and shall be firmly supported, unless otherwise
approved by the consultant.
12.2.4 Cables and flexible cords for final connections to luminaires shall be suitable for the operating temperature of the luminaire. Flexible cords for chain suspensions, if any shall have a white sheath unless otherwise indicated.

12.2.5 The size of final connection cables or flexible cords shall be as indicated.

12.2.6 Cables and cords passing close to ballast within a luminaire shall be suitable for the operating temperature of the ballast. Heat resistant sleeves shall be provided.

12.2.7 A protective conductor shall connect the earthing terminal or earthing contact of each luminaire to an earthing terminal incorporated in the adjacent conduit box. Where the final connection is by flexible cord the protective conductor shall form part of the cord.

12.2.8 Where luminaires are recessed in the false ceiling, luminaires shall be suspended with MS conduit with ball & socket arrangement, checknut etc. Suspension arrangement shall be fixed to steel/RCC structure with suitable purpose made clamps etc. (Cost of suspension arrangement is deemed to be included in the rate of installation/erection of luminaires). Contractor shall submit the shop drawing for proposed suspension arrangement of various types of light fixtures in various type of ceiling and shall obtain necessary approval from the Engineer-in-Charge.

12.2.9 The light fixtures and fans shall be assembled and installed in position complete and ready for service in accordance with the detailed drawings, manufacturer's instructions and to the satisfaction of the Engineer - In - Charge. Fixtures shall be suspended true to alignment plumb level and capable of resisting all lateral and vertical forces and shall be fixed as required. All ceiling fans shall be provided with suspension arrangement in the concrete slab/roof members. It shall be the duty of the contractor to make these provisions at the appropriate stage & locations shown on the drawings. Fan box with MS hook shall be as per CPWD specifications. Suspended type fluorescent light fixture shall be fixed to circular junction box with a metallic ball and socket arrangement. Light fixture in general shall be directly fixed to ceiling slab with rawl plugs. All switch and outlet boxes shall be bonded to earth through connector blocks. MS pipe shall be fixed with suitable fixing accessories and metal continuity shall be maintained.
ELECTRICAL INSTALLATION

1. **SCOPE**

   The scope of this section comprises of the fabrication, supply, erection, testing and commissioning of ELECTRICAL CONTROL PANELS, wiring and earthing for all components of the HVAC system confirming to these specifications in accordance with requirements of schedule of quantity and drawings.

2. **GENERAL**

   i) Unless otherwise specified in the tender specifications, all equipments and materials for electrical works shall be suitable for continuous operations on 415 V / 240 V ± 10 % (3 phase / single phase), 50 Hz. AC system.

   ii) All electrical works shall be carried out in accordance with the specification, local rules, Indian electricity act 1910 as amended upto date and rule issued there wide, regulations of the local fire insurance association and Indian standard code of practice IS – 732 including Indian electricity Rules, 1956 as amended to date.

   iii) All parts of electrical works shall be carried out as per appropriate CPWD General specifications for Electrical works, namely, Part I (Internal) 2005, Part II (External) 1994 work, and Part IV (Sub – Station), 2007 all as amended to date.

   iv) All materials and components used shall conform to the relevant IS specifications amended to date.

3. **WIRING SYSTEM**

   All power wiring shall be carried out with 650/1100 Volts grade PVC insulated aluminium conductor armoured cable, sized for starting current and continuous running current carrying capacity and by applying proper de-rating factor. Termination of conductors shall be by means of crimping. No joints shall be permitted.

4. **CONTROL PANELS**

4.1 **M.V. PANELS**

   All the M.V. panels shall be suitable for operation on 3 phase, 415 Volts, 50 Cycles, neutral grounded at transformer and short circuit level not less than 35 MVA at 415 Volts.

   The M.V. panels shall comply with the latest edition of relevant Indian Standards and Indian Electricity rules and regulations.

4.2. **CONSTRUCTION FEATURES**

   The M.V. Panels shall be metal enclosed sheet steel cubicle, indoor, dead front and floor mounting type and shall be fabricated as described in Package A of this tender.

   The M.V. panel shall be of adequate size with a provision of 20% spare space to accommodate possible future additional switch gear.

   Defeat interlocks shall be provided for isolating devices as specified keeping safety in mind. Mechanical and Electrical inter locking shall be provided as specified.
The power and control circuits shall have self aligning and self isolating contacts. The fixed and moving contacts shall be easily approachable for maintenance/replacement.

In case plug and socket arrangement is used for control connection, the design should ensure that only a particular plug can be inserted in the specific socket.

Withdraw-able modules shall have 3 positions i.e. service-test-isolated. In test position the power supply shall be disconnected but the control supply shall remain connected.

The draw out module shall have a latch arrangement before full draw-out position to prevent accidental fall of the module during removal. With the draw-out module removed, the live parts exposed in the panel, shall either be finger proof or shall be shrouded to prevent contact.

4.3 SWITCHGEAR & ACCESSORIES

The specifications for switchgears, accessories & its controls, metering shall be referred to Package A of this tender.

i) MOULDED CASE CIRCUIT BREAKERS (MCCB's)

MCCB shall be panel-mounted type. All the live parts of MCCB shall be enclosed in a moulded case and all contacts shall be silver-plated.

MCCB shall be trip-free with quick make and quick break operating mechanism.

The feeders for all those motors having more than or equal to 7.5 HP capacity shall be provided with fully automatic Star Delta starters with motor duty MCCBs for short circuit protection only(ICS = 100% ICU ) & Overload Relays with contactors of suitable range & ratings, for overload protection, while less than 7.5 HP motor shall have DOL starter. Single phase preventers shall be provided for all 3 phase motors. Single phase preventer shall be in conformity with relevant ISI standards. Single phase preventer shall act when the supply voltage drops down to 90 % of the rated voltage or failure of one or more phases. Single phase preventer shall be voltage operated and of approved make.

Other feeders of the panel which don’t require starter, shall be housed with:

a) MCCB with Thermal magnetic release & should provide adjustable setting for overload and short circuit protection with ICS = 100% ICU.

b) MCB used for controlling shall be with tripping characteristics of C curve. The miniature circuit breakers shall be 1/2/3/ 4 pole as per requirement. The breaking capacity of MCBs shall have minimum 10KA.

The protection devices of outgoing MCCB feeders shall be properly co-ordinated for tripping settings.

The fault level withstand capacity of the MCCB shall match that of the switchgear. Backup protective fuses shall not be used with MCCB for fault level compensation.
The operating handle of the MCCB shall be interlocked with the module door such that the door cannot be opened with the MCCB "ON".

The breaker handle shall indicate the operated position of the MCCB. When tripped on fault, the breaker handle shall occupy an intermediate position.

The terminals of the MCCB shall be able to accept the size of Aluminium conductor of the cables used.

The following capacity contactors and O/L relays shall be provided for different motors.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Motor Cap.</th>
<th>Type of Starter</th>
<th>O/L Relay Capacity</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>7.5 HP motor</td>
<td>Star Delta</td>
<td>16 Amps</td>
<td>6-12 Amps</td>
</tr>
<tr>
<td>2.</td>
<td>10 HP motor</td>
<td>Star Delta</td>
<td>32 Amps</td>
<td>6-12 Amps</td>
</tr>
<tr>
<td>3.</td>
<td>15 HP motor</td>
<td>Star Delta</td>
<td>32 Amps</td>
<td>10-16 Amp</td>
</tr>
<tr>
<td>4.</td>
<td>20 HP motor</td>
<td>Star Delta</td>
<td>63 Amps</td>
<td>16-22 Amp</td>
</tr>
<tr>
<td>5.</td>
<td>25 HP motor</td>
<td>Star Delta</td>
<td>63 Amps</td>
<td>16-22 Amp</td>
</tr>
<tr>
<td>6.</td>
<td>30 HP motor</td>
<td>Star Delta</td>
<td>63 Amps</td>
<td>20-32 Amp</td>
</tr>
<tr>
<td>7.</td>
<td>40 HP motor</td>
<td>Star Delta</td>
<td>70 Amps</td>
<td>28-42 Amp</td>
</tr>
<tr>
<td>8.</td>
<td>50 HP motor</td>
<td>Star Delta</td>
<td>70 Amps</td>
<td>28-42 Amp</td>
</tr>
<tr>
<td>9.</td>
<td>60 HP motor</td>
<td>Star Delta</td>
<td>70 Amps</td>
<td>30-45 Amp</td>
</tr>
<tr>
<td>10.</td>
<td>75 HP motor</td>
<td>Star Delta</td>
<td>110 Amps</td>
<td>45-70 Amp</td>
</tr>
<tr>
<td>11.</td>
<td>100 HP motor</td>
<td>Star Delta</td>
<td>200 Amp</td>
<td>60-100 Amp</td>
</tr>
<tr>
<td>12.</td>
<td>150 HP motor</td>
<td>Star Delta</td>
<td>270 Amp</td>
<td>70-110 Amp</td>
</tr>
<tr>
<td>13.</td>
<td>200 HP motor</td>
<td>Star Delta</td>
<td>390 Amp</td>
<td>120-160 Amp</td>
</tr>
</tbody>
</table>

Single-phase preventers shall be provided for all 3-phase motors. Single-phase preventer shall be in conformity with relevant ISI standards. Single-phase preventers shall act when the supply voltage drops down to 90% of the rated voltage or failure of one or more phases. Single-phase preventer shall be voltage operated and have approved make.

Control panel shall contain starters and safety arrangements for motors of various equipment as given in schedule of quantities. It shall also house the Air circuit breaker for main incoming supply, voltmeter, ammeter with selector switch for measuring the current drawn by each motor and indicating lights for incoming phases as well as status indication of each equipment.

All control panels shall be provided with detailed control circuit diagram indicating the terminal numbers and colour coding of the wires used in the panels. This diagram shall be pasted on the inner side of the cover and protected with PVC transparent lamination.

ON-OFF switches for each motor/equipment should not be provided on the cover of the control panel, but at the same time interlocking shall be provided between switch and the door in such a way that the door of the panel cannot be opened when the supply is ON.

4.4 POWER / CONTROL CABLING

Contractor shall provide all power/control cables from the motor control centre to various motors, level controllers and other control devices. All power cables shall be aluminium conductor XLPE insulated, ampurred and PVC sheathed. Therefore all
control cables shall be of copper conductor, PVC insulated, armoured and PVC sheathed. All cables shall have stranded conductors of 1100 Volts grade. The cables shall be in drum as far as possible and bear manufacturer’s name.

Specification of cable laying shall be followed as described in **Package A** of this tender. Cables and wires in conduits shall be laid on the metallic trays.

### 4.5 CABLE TRAYS

Contractor shall provide G.I perforated cable trays of sizes as given in Schedule of quantities. Detailed specification shall be followed as describe in **Package A** of this tender.

### 4.6 EARTHING

All three phase motor / equipments shall be earthed with two independent earth conductors as per the requirement of Indian electricity rules and regulations -1956.

Earthing specification shall be followed as describe in **Package A** on this tender.

### 4.7 DRAWINGS

Shop drawing for control panel and wiring of equipment showing the route of conduit/cables shall be got approved by the Engineer-in-charge before starting the fabrication of panel and starting the work. On completion two sets of completion/"As installed" drawings incorporating all details like conduit routes, number of wires in conduit, location of panels, switches, junction/pull boxes and cable route etc. shall be furnished by the contractor.

### 4.8 TESTING

Before commissioning of the equipment the entire Electrical Installation shall be tested in accordance with code of Practice IS:732-1963 (Revised) and test report furnished by a qualified and authorised person. The entire electrical installation shall be got approved by Electrical Inspector and certificate from Electrical Inspector shall be submitted. All tests shall be carried out in presence of Engineer-In-Charge.
SECTION – D – TECHNICAL SPECIFICATIONS HVAC WORK

1.0 GENERAL DESCRIPTION

This section covers the requirement of HVAC system to be provided as per specifications laid down below in subsequent sections & as per description of the item given under the schedule of work.

The tendered rate shall be deemed to include for all labours, materials, equipments, transportation, insurance, tools and all connected works for the completion of work to the extent described in the specifications,. The work shall be completed in all respects including safety measures to the entire satisfaction of Engineer-in charge and in accordance with all local laws, regulations, covering these types of installations.

Besides requirement specified under section scope of work & particular specification and in detailed specification of this packages, the following some highlighted in general are to be followed.

2.0 Basis of design:

A. CLIMATIC DATA

<table>
<thead>
<tr>
<th>Ambient Design conditions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td></td>
</tr>
<tr>
<td>Dry Bulb Temp.</td>
<td>43.3 deg C DB</td>
</tr>
<tr>
<td>Wet Bulb Temp.</td>
<td>24.0 deg C WB</td>
</tr>
<tr>
<td>Monsoon</td>
<td></td>
</tr>
<tr>
<td>Dry Bulb Temp.</td>
<td>35.0 deg C DB</td>
</tr>
<tr>
<td>Wet Bulb Temp.</td>
<td>28.3 deg C WB</td>
</tr>
<tr>
<td>Winter</td>
<td></td>
</tr>
<tr>
<td>Dry Bulb Temp.</td>
<td>5.6 deg C DB</td>
</tr>
<tr>
<td>Wet Bulb Temp.</td>
<td>4.4 deg C WB</td>
</tr>
</tbody>
</table>

B. OTHER PARAMETERS

| Inside Design conditions | 23.8 ± 1 deg C |
| Fresh Air                | 10 cfm per person |
| Lighting Load            | 2 watt/sq.ft. |
3.0 Designs, Drawings and technical submittal:

a) After Award of the Work:
On the basis of GFC drawing issued by the department, the Contractor shall submit 03 (Three) sets of technical submittal of item to be procured and shop drawings for the entire HVAC installations to be provided under this contract along with supporting design calculations, charts etc, and proposed General Arrangement drawings for major equipments within 30 (Thirty) days for approval of PMC/ Consultants before proceeding with the work. He shall also furnish all clarifications and explanations as may be desired by PMC/ Consultants promptly for early finalization of the design.

The work to be executed as per approved shop drawings & technical submittal.

b) On Completion of Work:
The contractor shall submit sets of O & M manuals for HVAC System as detailed subsequent section(s) including MCC panels, Circuit Diagram, Manufacturers technical catalogues, detailed specification of items provided along with soft copy of As-built drawings and copies of Test Certificates of all major equipments duly bound in neat and presentable booklet forms within 30 days of completion of the work.

The contractor shall furnish and install in the plant room a neatly typed set of operating instructions securely framed and glazed as per the directions of the Engineer.

4.0 Approval by Local Fire Service / local authorities etc
On successful completion of work, the contractor shall incorporate all changes as approved by the Service / local authorities etc that might have been effected during execution of the work.

The contractor shall also bring to the notice of the Engineer-in-charge any deviations from Local Fire Service/Building Bye Laws Norms and requirements in the systems that he shall install as well as architectural features that will affect approval from the Fire Service. No extra charges shall be paid on account of interaction with the Fire Service.

5.0 Coordination
The Contractor shall be required to co ordinate his activities with all other services such as Air Conditioning, Electrical and Civil (Interiors) etc.

6.0 Civil Works
All civil works are included in Contractor’s scope of work unless otherwise specified. Civil works like chasing in the wall/ceiling or making hole in the RCC floor/ceiling or in brick wall for piping, grouting etc. including making good after completion, small size pedestals or any other minor civil works required in connection with the installation of the system are included in the scope of work of this contract and it shall be deemed to be included in the contractor’s scope of work.

7.0 Guarantee & defects liability period
The contractor shall guarantee that all equipments shall be free from any defects, defective materials and/or bad workmanship and that the equipment shall operate...
satisfactorily and their performance and efficiencies of the equipment shall not be less than the guaranteed values. The guarantee shall be valid for a period of 12 (Twelve) months after successful completion of second seasonal test and “taking over”. Any equipment or parts found defective shall be replaced free of all costs by the contractor. This period shall be known as the Defects Liability Period and shall be reckoned from the date the Engineer certifies and plant is taken over as laid down in clause “Taking over of Plant” hereinafter. The services of the contractors personnel, if requisitioned during this period for such work, shall be made available free of all costs to the owner.

8.0 **Test on completion**

Tests on completion shall mean such tests as are prescribed in the specifications or have been mutually agreed to between the contractor and the department to be made before the plant is taken over. In case tests are not possible due to climatic conditions at the time of completion, the contractor shall be bound to carry out tests as prescribed thereafter at any time subsequent to the date of completion. The defect liability period will start only after all the test had been successfully completed.

9.0 **Taking over of plants**

Provisional take over of the plant shall be made only after successful run of the HVAC system round the clock for seven days after commissioning. However, final take over shall be after successful conducting of summer and monsoon seasonal tests.
SPLIT SYSTEM AIR CONDITIONERS

1.0 SCOPE

The contractor shall supply, installation, testing and commissioning of split system air conditioners as per schedule of quantity enclosed. The system shall be complete in all respects and comply with the specifications as given below.

2.0 Outdoor Unit- Condensing Units

2.1 Each condensing unit shall be complete complete with hermetic reciprocating/rotary compressor(s), aircooled condenser, condenser fans with motors, internal piping, switches and internal wiring and shall be enclosed in a weather proof out door type housing.

2.2 The compressor shall be hermetic, with enclosed gas cooled motor. The compressor's shall be suitable for R-22.

2.3 The condenser coil shall be air cooled type with aluminium fins and copper tubes and necessary refrigerant connections. The copper tubes shall not be less than 1/2" O.D.

2.4 The condenser air fans shall be propeller type direct driven, each complete with motor. The air quantity and area of the condenser shall be adequate for working in the specified out door conditions.

2.5 The casing shall be fabricated from galvanised steel, zinc phosphated and finished with baked enamel paint. The casing shall make the whole unit fully weather proof, suitable for out door installation.

2.6 The unit shall include a remote control assembly with thermostat and speed switches.

2.7 The necessary charge of refrigerant gas and lubricated oil shall be provided to run the system.

3.0 INDOOR UNIT

3.1 HIGH WALL MOUNTED TYPE

The unit shall be decorative wall mounted type. The cabinet is constructed out of durable flame resistance acrylonitrile-butadiene-styrene and shall include pre filter, fan section, coil section, etc. The body shall be light in weight. The indoor unit shall be of approved model & colour by Engineer-in-charge.

The fan shall be aerodynamically designed diffuser turbo fan type. The fan shall be mounted directly on motor shaft having supported from housing. The fan shall be direct driven type.

The cooling coil shall be of seamless copper tubes, and shall have continuous aluminium fins. The fins shall be spaced by collars forming integral part of the fins. The tubes shall be staggered in the direction of air flow. The fins shall be uniformly bonded to the tubes by mechanical expansion of the tubes. The coils shall be tested against leaks.
Unit shall have filter cleanable type of resin net (with mold resistant) fixed to an intergrally moulded plastic frame. The filter should be slid away type but neatly inserted.

Unit shall have a external attractive casing for supply and return air.

**Control**

Each unit shall be with corded remote controller to operate maintain inside conditions.

**Testing**

The indoor unit shall be tested to measure air quantity and coil performance by measuring temperature difference, and then calculating the capacity.

4.0 **MISCELLANEOUS**

4.1 The unit shall have control panel, housing the starting switches, contactor, relays etc.

4.2 Drain line shall be provided from fan coil unit upto drain trap. (To be priced separately).

4.3 Suitable M.S. angle iron supporting frame shall be provided for the condensing unit and supporting arrangement for the indoor units.

4.4 Interconnecting power and control cabling shall be provided between condensing unit and evaporator unit.
PROPELLER FAN

1.0 SCOPE

The Scope of this section comprises supplying, storing, erection, testing and commissioning of Inline Fan, Axial Fan & Propeller Fan conforming to these Specifications and in accordance with requirements of schedule of quantities.

2.0 PROPELLER DECORATIVE FAN

i) Propeller fans shall be direct – driven, three or four blade type, mounted on toilet wall.

ii) Fan blades shall be constructed of aluminium, PVC or steel. Fan hub shall be of heavy welded steel/Aluminium construction with blades bolted to the hub. Fan blades and hub assembly shall be statically and dynamically balanced at the factory.

iii) All required accessories as required as per site requirement.

2.1 INSTALLATION

The Contactor shall supply all required bolts, base frame(wherever required), vibration isolators any other accessories and shall assure that the components are placed securely in proper position.

2.2 TESTING

All the fans shall be tested for performance at the factory and the following test results shall be furnished.

i) C F M

ii) Static pressure at the specified flow rate

iii) KW input to motor
PIPE WORK

1.0 SCOPE

All piping work shall conform to quality standards and shall be carried out as per specifications and details given hereunder:-

2.0 PIPING

2.1 DRAIN PIPING

2.1.1 The drain piping shall be UPVC.

2.1.2 The fittings shall be of same material.

2.1.3 Pipe crosses shall be provided at bends, to permit easy cleaning of drain line.

2.1.4 The drain line shall be provided upto the nearest drain trap and pitched towards the trap.(As shown in drawings)

2.1.5 Drain lines shall be provided at all the lowest points in the system, as well as at equipment, where leakage of water is likely to occur, or to remove condensate and water from pump glands.

2.2 COPPER PIPING

2.2.1 Seamless soft copper tubing, type L shall be used to make connections to equipment, wherever required or specified.

2.2.2 Flare fittings e.g. flare nuts, tees, elbows, reducers etc. shall all be of brass.

2.3 REFRIGERANT PIPING

2.3.1 The condensing unit and evaporator unit shall be interconnected by type ‘L’ seamless copper refrigerant liquid and suction lines using flared or brazed fittings. Necessary accessories shall be incorporated in the circuit.

2.3.2 The suction line shall be insulated with two layer of 6 mm nitrile rubber insulation.

2.3.3 Testing pressure for pipe will be 700 PSI.

2.3.4 Pipe will be properly cleaned.

2.3.5 Pipe shall be tested as per eddy current procedure.
**LIST OF INDICATIVE MAKES:**

The following is the list of products and indicative makes. Bidder is free to propose any other equivalent Make meeting entire Technical Requirements, Specifications along with required details in support of the same. The same would be analyzed and accepted if found suitable after discussion between EPI and bidder. The Makes shall be finalized during Technical evaluation prior to opening of Price-Bids.

Bidders are required to offer reputed equipment / component which is strictly meeting technical requirements, enclosed specifications along with NIT and other relevant / latest applicable Standards & Rules.

**LIST OF APPROVED & PREFERRED VENDORS**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Name of Items</th>
<th>List of approved manufacturers / brand / applicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Civil Works</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Cement</td>
<td>ACC / Grasim / Ambuja / Ultratech / Lafarge</td>
</tr>
<tr>
<td>2.</td>
<td>Reinforcement Steel TMT Bars (Fe 500 grade) &amp; TMT Re-bars conforming to IS 1786-2008 Fe500 corrosion resistant steel grade</td>
<td>SAIL, TISCO, RINL</td>
</tr>
<tr>
<td>4.</td>
<td>Hardware Like: Mortice Lock With Pair Of Handles, Recess Handle Fittings, Floor Spring, Door Closer, Tower Bolts, Floor door stoppers Etc.</td>
<td>Dorma GMBH &amp; Co.KG , D-Line Carl F International a/s, LUGGAGE LINK, Hafele India (P) Ltd</td>
</tr>
<tr>
<td>5.</td>
<td>Structural Steel, MS Plates, ISMB Etc.</td>
<td>SAIL, Tata Steel Limited, Rashtriya Ispat Nigam Ltd. (RINL), APOLLO, JINDAL STEEL</td>
</tr>
<tr>
<td>7.</td>
<td>Fire Rated Doors</td>
<td>Promat International (Asia Pacific) Ltd., Sukri Paints &amp; Chemicals, Navair International Ltd., Shakti mat fire check door</td>
</tr>
<tr>
<td>8.</td>
<td>Flush Doors</td>
<td>Greenply Industries Limited, Century Plyboards (I) Ltd, Mayur Plyboard Industries( P) Ltd</td>
</tr>
<tr>
<td></td>
<td>Product Description</td>
<td>Manufacturers</td>
</tr>
<tr>
<td>---</td>
<td>-------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>10.</td>
<td>Ceramic Tiles / Vitrified Tiles</td>
<td>Somany Tiles Limited, Kajaria Ceramics Ltd., RIWASA TILE LTD, NITCO Tiles Ltd., Orient Ceramics and Industries Ltd</td>
</tr>
<tr>
<td>11.</td>
<td>High Performance Glass / Clear Glass</td>
<td>Saint Gobain, Pilkington glass India Pvt Ltd, Emirates Glass L.L.C.</td>
</tr>
<tr>
<td>15.</td>
<td>Compact Laminate Toilet Cubical</td>
<td>Merino Industries ltd, Green Sturdo Greenply Industries Limited, SPCMS (Solace ), Shapoorji Pallonji &amp; co. Ltd</td>
</tr>
<tr>
<td>17.</td>
<td>C.P. Fittings</td>
<td>Kohler Co., Jaquar &amp; Co. Ltd., GROHE</td>
</tr>
<tr>
<td>18.</td>
<td>S.S. Sink</td>
<td>Nirali, Franke</td>
</tr>
<tr>
<td>19.</td>
<td>G.I. Pipe</td>
<td>Tata Steel Limited, Jindal Pipe Industries</td>
</tr>
<tr>
<td>20.</td>
<td>CPVC Pipes</td>
<td>Supreme/ Prince/ Ori-Plast</td>
</tr>
<tr>
<td>23.</td>
<td>Glass Mirror</td>
<td>Modi Guard, Atul Ltd</td>
</tr>
<tr>
<td>25.</td>
<td>Gypsum False Ceiling</td>
<td>India Gypsum / Saint Gobain, Beral Gypsum, Lfarge Boral Gypsum</td>
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<tr>
<td>26.</td>
<td>Calcium Silicate tile false ceiling</td>
<td>Aerolite, Ramco, Prompt</td>
</tr>
<tr>
<td>27.</td>
<td>Galvalum Double skin insulated Roofing System</td>
<td>TATA BLUESCOPE STEEL LIMITED, Ispat Industries Ltd., Safizip Steel Stand Seam Roofing (I) Ltd., Interarch Steel Ltd., Blue scope Steel, Lloyd Insulation (India) Ltd</td>
</tr>
<tr>
<td>28.</td>
<td>Laminates</td>
<td>Merino Industries ltd, Greenply Industries Limited, SUNMICA, The Bombay Burmah Trading Corporation Ltd, Sunmica India Division</td>
</tr>
<tr>
<td>29.</td>
<td>Veneer</td>
<td>Century Plyboards (I) Ltd, Greenply Industries Limited, Sarda Plywood Industries Ltd (DURO)</td>
</tr>
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<tr>
<td><strong>30.</strong></td>
<td>Protective Paints</td>
<td>Akzo Nobel Coatings India Pvt. Ltd., Jotun India Private Limited, Berger Paints India Ltd., Asian Paints Ltd.</td>
</tr>
<tr>
<td><strong>31.</strong></td>
<td>FLY ASH BRICKS</td>
<td>Sand Plast India Ltd., KJS CONCRETES, Shiv shakti, Hindustan tile</td>
</tr>
</tbody>
</table>

**B Sanitary Items**

<p>| | | |</p>
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<thead>
<tr>
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</thead>
<tbody>
<tr>
<td><strong>1.</strong></td>
<td>C.P Angle Valve</td>
<td>PARRYWARE/ ROCA, Kohler Co., JAQUAR</td>
</tr>
<tr>
<td><strong>2.</strong></td>
<td>Plastic W.C Seats with cover (Except where to be supplied with WC)</td>
<td>ADMIRAL, COMMANDER</td>
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<tr>
<td><strong>3.</strong></td>
<td>Hand dryer/ Tissue paper holder</td>
<td>EURONICS, UTEC, JAQUAR</td>
</tr>
<tr>
<td><strong>4.</strong></td>
<td>Sensor Operated Flushing System</td>
<td>UTEC, EURONICS, SCHELL</td>
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<td><strong>5.</strong></td>
<td>Liquid Soap Dispensor</td>
<td>EURONICS, KIMBERLEY CLARK, UTEC</td>
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<td><strong>6.</strong></td>
<td>Air Purifier / Aerosol Dispenser</td>
<td>EURONICS, UTEC, JAQUAR</td>
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<tr>
<td><strong>7.</strong></td>
<td>C.P Bottle Trap</td>
<td>JAQUAR, VJAY METAL WORKS</td>
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<tr>
<td><strong>8.</strong></td>
<td>Multi-Pan WC Connector</td>
<td>VIEGA, MCALPINE</td>
</tr>
<tr>
<td><strong>9.</strong></td>
<td>C.P Angle Valve</td>
<td>PARRYWARE/ ROCA, KOHLER CO. JAQUAR</td>
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<td><strong>10.</strong></td>
<td>Stainless Steel Sink</td>
<td>AMC, JAYNA, NEELKANTH</td>
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<td><strong>11.</strong></td>
<td>Health Faucet</td>
<td>CHILLY, Kohler Co., JAQUAR</td>
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<td><strong>12.</strong></td>
<td>Electrical Water Heater / Geyser</td>
<td>VENUS, BRAUN, AO SMITH</td>
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<td><strong>13.</strong></td>
<td>R.O. Drinking water system</td>
<td>EUREKA FORBES, SIMA LABS, ION EXCHANGE</td>
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<td><strong>14.</strong></td>
<td>Water Cooler / Dispensors</td>
<td>EUREKA FORBES, BLUESTAR, OASIS INTERNATIONAL</td>
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<td><strong>15.</strong></td>
<td>CP / SS Grating for Floor Trap &amp; Floor Drain</td>
<td>VJAY METAL WORKS, ACO, NEER</td>
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</tbody>
</table>

**i) PLUMBING LOW SIDE (PIPES & FITTINGS)**

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<table>
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<tr>
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<tr>
<td><strong>16.</strong></td>
<td>G.I. pipes</td>
<td>TATA, JINDAL, SURYA ROSHNI</td>
</tr>
<tr>
<td><strong>17.</strong></td>
<td>G.I. Fittings for Water Supply (Malleable)</td>
<td>R.M. Engg. Works, UNIK, Zoloto</td>
</tr>
<tr>
<td><strong>18.</strong></td>
<td>G.I./M.S Forged Steel pipes &amp; fittings I.S:1239 (Part-II)</td>
<td>Vijay Cycle &amp; Steel Industries, DRP, TRUE FORGE</td>
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<tr>
<td><strong>19.</strong></td>
<td>CPVC Pipes</td>
<td>ASTRAL FLOWGUARD, ASHIRVAD FLOWGUARD, AJAY FLOWGUARD</td>
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<tr>
<td><strong>20.</strong></td>
<td>SS Pipes</td>
<td>JINDAL STAINLESS, RAMPART</td>
</tr>
<tr>
<td><strong>21.</strong></td>
<td>PP-R Pipes</td>
<td>SFMC, FUSION, VECTUS</td>
</tr>
<tr>
<td><strong>22.</strong></td>
<td>Composite Pipes</td>
<td>JINDAL HISSAR, KITEC</td>
</tr>
<tr>
<td><strong>23.</strong></td>
<td>UPVC pipes</td>
<td>SUPREME, AKG, FINOLEX, PRINCE</td>
</tr>
<tr>
<td><strong>24.</strong></td>
<td>HDPE Pipes</td>
<td>JAIN PIPES, ORIPLAST</td>
</tr>
<tr>
<td><strong>25.</strong></td>
<td>Sand Cast Iron Pipes &amp; fittings</td>
<td>NECO, HEPCO, SRIF</td>
</tr>
<tr>
<td><strong>26.</strong></td>
<td>Sand Cast Iron Pipes &amp; fittings</td>
<td>NECO, HEPCO,</td>
</tr>
<tr>
<td><strong>27.</strong></td>
<td>SWR Pipes</td>
<td>FINOLEX, AKG, SUPREME, PRINCE</td>
</tr>
<tr>
<td><strong>28.</strong></td>
<td>Stoneware pipes &amp; Gully Trap</td>
<td>ANAND, BK CERAMICS INDUSTRY,</td>
</tr>
<tr>
<td><strong>29.</strong></td>
<td>RCC PIPES</td>
<td>INDIAN HUME PIPE, KRISHNA SPUN PIPES, OM SPUN PIPE,</td>
</tr>
<tr>
<td><strong>30.</strong></td>
<td>CILA pipes</td>
<td>KESORAM, NECO, ELECTROSTEEL</td>
</tr>
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<td><strong>31.</strong></td>
<td>C.I. fittings</td>
<td>NEEL, KARTAR, SARKAR</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Manufacturers</td>
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<tr>
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<td>32.</td>
<td>D.I. pipes</td>
<td>KESORAM, ELECTROSTEEL, JINDAL HISSAR</td>
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<tr>
<td>33.</td>
<td>D.I. fittings</td>
<td>KARTAR, ELECTROSTEEL</td>
</tr>
<tr>
<td>34.</td>
<td>Insulation For Hot water Pipes</td>
<td>KAIFLEX, ARMAFLEX, THERMAFLEX</td>
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<tr>
<td>35.</td>
<td>Insulation For External / Exposed Hot water Pipes</td>
<td>KAIFLEX, ARMAFLEX</td>
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<tr>
<td>36.</td>
<td>Pipe protection For External Water Supply Pipes</td>
<td>PYPKOTE, MAKPOLYKOTE, ARMAFLEX</td>
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<tr>
<td>37.</td>
<td>Pipe Joint Sealant for Cast Iron Pipes</td>
<td>PIPESEAL, DRIPSEAL</td>
</tr>
<tr>
<td>38.</td>
<td>Pre-Fabricated Structural supports and clamps</td>
<td>CHILLY, EASYFLEX, CAMRY</td>
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<tr>
<td>39.</td>
<td>Paints</td>
<td>ASIAN PAINTS, BERGER</td>
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<tr>
<td>ii</td>
<td>PLUMBING LOW SIDE (VALVES &amp; RELATED ACCESSORIES)</td>
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<tr>
<td>40.</td>
<td>Gunmetal Fullway Valve</td>
<td>ZOLOTO, LEADER, SANT</td>
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<tr>
<td>41.</td>
<td>Gunmetal Fullway Valve</td>
<td>LEADER, SANT, ZOLOTO</td>
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<tr>
<td>42.</td>
<td>Ball valve</td>
<td>ARCO, CIM, TIEMME</td>
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<tr>
<td>43.</td>
<td>Ball valve w/ In-Built Filter</td>
<td>ARCO, RB</td>
</tr>
<tr>
<td>44.</td>
<td>Butterfly Valve</td>
<td>KSB, SKS, AIP</td>
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<tr>
<td>45.</td>
<td>Air Release Valve</td>
<td>RBM, TIEMME, SKS</td>
</tr>
<tr>
<td>46.</td>
<td>Float valve (gunmetal) upto 40mm</td>
<td>LEADER, CSE ENGINEERS, APAR</td>
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<tr>
<td>47.</td>
<td>Float valve (C.I) 50mm and above</td>
<td>LEADER, CSE ENGINEERS, APAR</td>
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<tr>
<td>48.</td>
<td>Altitude / Equilibrium Float Valve</td>
<td>CSA, HONEYWELL, DANFOSS</td>
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<tr>
<td>49.</td>
<td>C.I Strainer more than 65mm dia.</td>
<td>LEADER, SANT, AIP</td>
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<tr>
<td>50.</td>
<td>Pressure Reducing Valve</td>
<td>RBM, TIEMME, SKS</td>
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<tr>
<td>iii</td>
<td>PLUMBING EXTERNAL ITEMS</td>
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<tr>
<td>51.</td>
<td>C.I Manholes cover</td>
<td>NECO, KARTAR, RIF</td>
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<tr>
<td>52.</td>
<td>SFRC Manhole Cover &amp; Gratings</td>
<td>KGM Associates, ABC-ACCURATE BUILDCON, SURABH</td>
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<tr>
<td>53.</td>
<td>Plastic Encapsulated Foot Rest</td>
<td>KGM Associates</td>
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<td>iv</td>
<td>SOLAR HOT WATER GENERATION SYSTEM</td>
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<td>54.</td>
<td>Solar Heating Sytems</td>
<td>INTER-SOLAR, SRIRAM GREENTECH</td>
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<td>C</td>
<td>Internal &amp; External Electrical Works</td>
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<tr>
<td>2.</td>
<td>Moulded Case Circuit Breaker &amp; Air Circuit Breakers</td>
<td>L &amp; T, Siemens, GE Power Control Schneider Electric, Eaton</td>
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<tr>
<td>3.</td>
<td>Meter &amp; Instruments Selector Switches, CT’s Indicating Lamps</td>
<td>Rishline (L &amp; T), AE, G &amp; M (Gilbert &amp; Maxwell), Kappa Technic, Kaycee</td>
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<tr>
<td>4.</td>
<td>Distribution Boards with Miniature Circuit Breakers, RCCB / ELCB, Isolator.</td>
<td>Schneider Electric (Multi 9), Legrand L &amp; T, Siemens, Hager</td>
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<tr>
<td>5.</td>
<td>Power Cable 1.1 KV Grade XLPE InsulatedAL Conductor Armoured Cables (FR Type).</td>
<td>Finolex, KEI, Skytone, Gemscab Polycab</td>
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<tr>
<td>6.</td>
<td>PVC Insulated copper conductor single core stranded wires of 650/1100 volt grade (FR &amp; FRLS Type)</td>
<td>Skytone, Bonton, Polycab, Finolex Batra Henlay, Havells</td>
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<tr>
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<td>Description</td>
<td>Brands</td>
</tr>
<tr>
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<td>7</td>
<td>Telephone Wires</td>
<td>Skytone, Bonton, Polycab, Finolex</td>
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<tr>
<td></td>
<td></td>
<td>Batra Henlay, Havells</td>
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<tr>
<td>8</td>
<td>Modular Type Light &amp; Power Accessories (Switches, Socket etc.) M.S. Switch Boxes Series</td>
<td>Legrand (Mosaic Range), Schneider Electric (Clipsal -H 2000 Mega)</td>
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<td></td>
<td></td>
<td>Wipro (North- West)</td>
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<td>9</td>
<td>M.S. Conduit (ISI Marked).</td>
<td>BEC, AKG, NIC, AGL</td>
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<td>10</td>
<td>PVC Conduit (ISI Marked).</td>
<td>BEC , Precision, AKG, S &amp; G Control &amp; Switchgear (P) Ltd., Polypack</td>
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<td>11</td>
<td>M.S. Conduit Accessories</td>
<td>Rama, Sharma Sales Corporation</td>
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<td>12</td>
<td>Telephone Tag Block</td>
<td>Krone, TVS R&amp;M</td>
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<tr>
<td>13</td>
<td>Cable Tray</td>
<td>Pilco, Slotco, Needo</td>
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<tr>
<td>14</td>
<td>Cable Lugs</td>
<td>Comet, Dowells, Multi, Lapp Kabel</td>
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<tr>
<td>15</td>
<td>Cable Glands</td>
<td>Commet, Gripwell, Dowells, Lapp Kabel</td>
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<tr>
<td>16</td>
<td>Ceiling Fan</td>
<td>Orient, Usha, Crompton</td>
</tr>
<tr>
<td>17</td>
<td>Exhaust Fan</td>
<td>Alstom, Usha, Havells</td>
</tr>
<tr>
<td>18</td>
<td><strong>Light Fixtures &amp; Lamps</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(a) Fluorescent Light Fixtures, CFL &amp; LED lights</td>
<td>Neer Energy, Wipro, Philips, Eglo, HPL</td>
</tr>
<tr>
<td></td>
<td>(b) External lighting Fixtures</td>
<td>Neer Energy, Schereder, Philips, Ligman</td>
</tr>
<tr>
<td>19</td>
<td><strong>Fire Detection &amp; Alarm System</strong></td>
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<tr>
<td>20</td>
<td>Detectors &amp; Devices :- Intellignt Optical &amp; Ionisation Type Smoke Detector, Heat Detector, Control Module, Fault Isolator.</td>
<td>Notifier, Cooper Safety , Morley IAS</td>
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<td>21</td>
<td>Response Indicator</td>
<td>Daksh, Tyco, Agni.</td>
</tr>
<tr>
<td>22</td>
<td>Addressable Main Fire Alarm Panel</td>
<td>Notifier, Cooper Menvier, Morley IAS</td>
</tr>
<tr>
<td>23</td>
<td>Amplifier, Speaker / Hooter, Microphone, P.A. Console, LMT</td>
<td>ATIES, Ahuja, Bosch</td>
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<tr>
<td>24</td>
<td>UPS</td>
<td>APC, Aros (PCI), Emerson</td>
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<tr>
<td>25</td>
<td>MS Poles</td>
<td>Schereder , Bajaj, Surya, Glowmac</td>
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<td>D</td>
<td><strong>Fire Fighting &amp; Prevention Works</strong></td>
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<td>1</td>
<td>M.S. Pipes</td>
<td>TATA, Jindal Hissar, Surya Roshni</td>
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<tr>
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<td>Forged Steel Fittings</td>
<td>Sudarshan Steels, MEC (Jainsons), Vijay Cycle &amp; Steel Industries</td>
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<tr>
<td>3</td>
<td>Butt Welded Fittings</td>
<td>DRP, True Forge, Sudarshan Steels</td>
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<td>4</td>
<td>D.I. Grooved Coupling Fittings</td>
<td>VICTAULIC, VEXOMICA, MEC (JAINSONS)</td>
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<tr>
<td>5</td>
<td>Ball Valve</td>
<td>ARCO, CIM, Tiemme</td>
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<tr>
<td>6</td>
<td>Butterfly Valve (upto PN 16)</td>
<td>KSB, SKS, Advance</td>
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<tr>
<td>7</td>
<td>Butterfly Valve (upto PN 20)</td>
<td>AIP, MONSHER</td>
</tr>
<tr>
<td>8</td>
<td>Air Release Valve</td>
<td>SANT, IVC, LEADER</td>
</tr>
<tr>
<td>9</td>
<td>C.I. Double flanged sluice valves</td>
<td>Kirloskar, Sant, Leader</td>
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<tr>
<td>10</td>
<td>C.I. Double flanged Non return valve</td>
<td>Kirloskar, Sant, Kartar</td>
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<tr>
<td>11</td>
<td>Dual Plate / Wafer Type Non Return Valve (upto PN 16)</td>
<td>Advance, KSB, C&amp;R</td>
</tr>
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<td>12</td>
<td>Dual Plate / Wafer Type Non Return Valve (PN 20)</td>
<td>AIP, Monser</td>
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<tr>
<td>13</td>
<td>Fire Extinguisher</td>
<td>Supreex, Lifeguard, Safeguard</td>
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<tr>
<td>14</td>
<td>Firstaid Hose Reel</td>
<td>Supreex, Eversafe, Newage</td>
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<tr>
<td>15</td>
<td>Thermo Plastic Hose Reels for Drums</td>
<td>Kesara Plast, Mitras, Eversafe</td>
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<td>16</td>
<td>Branch Pipe, Nozzle Coupling etc.</td>
<td>Supreex, Safeguard, Newage</td>
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<tr>
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<td>Description</td>
<td>Make/Brand</td>
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<tr>
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<tr>
<td>17</td>
<td>Hosebox</td>
<td>Reputed make as per IS Specifications</td>
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<td><strong>D</strong></td>
<td>HVAC Works</td>
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</tr>
<tr>
<td>1</td>
<td>Chiller (Screw type)</td>
<td>York/Carrier/McQuay/Trane/Climaveneta/Clivet</td>
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<tr>
<td>2</td>
<td>Pumps</td>
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</tr>
<tr>
<td>2.1</td>
<td>Pumps</td>
<td>Grundfoss/ITT Bell &amp; Gossett/Armstrong/Kirloskar/Mather &amp; Platt</td>
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<td>VFD of Pump</td>
<td>ABB/Honeywell/Danfoss/Vecon</td>
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<td>3</td>
<td>Airhandling units</td>
<td>Zeco/Waves/Edgetech/Flaktwood/Lloyd</td>
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<td>3.1</td>
<td>Motor of AHU</td>
<td>Havells / Crompton / ABB / Siemens / Marathon</td>
</tr>
<tr>
<td>3.2</td>
<td>Blower of AHU / FCU</td>
<td>Nicotron / Krugar / Flakt / Wolter / Greenheck</td>
</tr>
<tr>
<td>3.3</td>
<td>Cooling Coil</td>
<td>AHRI approved</td>
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<tr>
<td>4</td>
<td>FCU</td>
<td>Edgetech / Hitech / Emerald / Zeco / Flowel</td>
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<tr>
<td>5</td>
<td>Cooling Tower</td>
<td>Paharpur / Bell / Case / Advance</td>
</tr>
<tr>
<td>6</td>
<td>Propeller Fan</td>
<td>Dapass / GE / Crompton</td>
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<tr>
<td>7</td>
<td>Axial Flow Fan</td>
<td>Kruggar / Nicotron / Dustech / Humidin / Airflow</td>
</tr>
<tr>
<td>8</td>
<td>Inline Fan</td>
<td>Airflow / Caryaire / Ostberg / Greenheck / Sphere</td>
</tr>
<tr>
<td>9</td>
<td>Grilles / diffuser / damper</td>
<td>Caryaire / Airflow / Airmaster / Flowel / Dynamic Equipment</td>
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<tr>
<td>10</td>
<td>Factory Made duct</td>
<td>Ductofab / Zeco / Rolastar</td>
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<td>10.1</td>
<td>G.I. Sheets</td>
<td>Tata / Sail / Nippon / National</td>
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<td>11</td>
<td>Fire Dampers</td>
<td>Ravistar / Airmaster / Caryaire / Airflow</td>
</tr>
<tr>
<td>12</td>
<td>Flexible Duct</td>
<td>Atco / UP Twiga / Sphere</td>
</tr>
<tr>
<td><strong>13</strong></td>
<td>Electric &amp; Motor Controls</td>
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30 2 way PID valve with thermostat & actuator | Honewell / Danfoss / Oventrop / Belimo
31 Airvent | Rapid Cool / Anergy / Johnson
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41 UPVC Pipes | Jain / Hindustan / Prakash / Universal
42 Nitrile Rubber | Aflex / Kflex / Armacell
43 Polyethylene | Paramount / Supreme / Trocellene

Note: Items which are not mentioned in above list but required at site, shall be supplied with prior approval of EPI.
# LIST OF TENDER DRAWINGS

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